



**Manchester
Metropolitan
University**

Lackenbauer, Wolfgang (2019) An exploration of keep/refer decision making abilities of Austrian undergraduate physiotherapy students in a changing practice environment. Doctoral thesis (PhD), Manchester Metropolitan University.

Downloaded from: <https://e-space.mmu.ac.uk/625928/>

Usage rights: Creative Commons: Attribution-Noncommercial-No Derivative Works 4.0

Please cite the published version

<https://e-space.mmu.ac.uk>

**An exploration of keep/refer decision
making abilities
of Austrian undergraduate
physiotherapy students
in a changing practice environment**

W Lackenbauer

PhD 2019

**An exploration of keep/refer decision
making abilities
of Austrian undergraduate
physiotherapy students
in a changing practice environment**

Wolfgang Lackenbauer

**A thesis submitted in partial fulfilment of
the requirements of Manchester
Metropolitan University for the degree of
Doctor of Philosophy**

**Department of Health Professions
Manchester Metropolitan University**

2019

Abstract

Background: This thesis was initiated in the light of developments within the Austrian health care sector with physiotherapists being included for the first time as part of the planning for how the national health care system should be developed (Physio Austria, 2014). In addition, there is of an ongoing effort from the Austrian physiotherapy association to implement a direct access system to physiotherapy in Austria (Baumgartner, 2013; Bauer-Horvath, 2015; Sorge, 2017). This warrants the development of an evidence based curriculum that properly prepares Austrian physiotherapy students and newly qualified physiotherapists to make autonomous keep/refer decisions and to recognise the presence of serious pathologies which require a medical referral.

Aim: The aim of this thesis was to provide recommendations for keep/refer decision making and the identification of serious pathologies for undergraduate physiotherapy curricula in Austria.

Methods: An explanatory mixed methods study which consisted of a survey among European final year undergraduate physiotherapy students (chapter 5), a survey among Austrian medical doctors (chapter 6) and a mixed methods randomised pilot study among Austrian final year undergraduate physiotherapy students (chapter 7) was carried out.

Results: ● In comparison to students from other European countries (e.g. the Netherlands, Estonia), Austrian final year undergraduate physiotherapy students are currently insufficiently trained to detect serious pathologies which require a medical referral based on clinical vignettes. Austrian physiotherapy students believed that screening for serious pathologies is not exclusively the task of physicians and making independent keep/refer decisions should be mandatorily taught as independent lectures during the undergraduate curriculum (chapter 5). ● The majority of responding Austrian physicians deemed the ability to make autonomous keep/refer decisions to be highly relevant for the physiotherapy education and profession in Austria as a whole. Austrian physicians suggested a wide range of different examination procedures which should be included in the undergraduate curriculum (chapter 6). ● A single-hour CBL educational intervention which aimed to improve the keep/refer decision making abilities of Austrian undergraduate physiotherapy students was found to be feasible and acceptable. A potential effectiveness of a single hour, CBL educational intervention could however not be demonstrated (chapter 7).

Implications: Based on the results of this thesis, several recommendations for future research and education for keep/refer decision making and the identification of serious pathologies for undergraduate curricula in Austria are made (chapter 9).

Table of Contents

Acknowledgements.....	9
Dissemination	10
List of Appendices	12
List of Tables	14
List of Figures	16

Chapter 1: Background and Research Context.

1.1 Introduction and structure of the thesis.....	19
1.2 Physiotherapy as a profession within the health care system: The definition by the World Confederation of Physical Therapy (WCPT).	21
1.3 Direct access to physiotherapy service: A risk for patients or advantageous for the health care systems?	21
1.4 The physician's referral: Is it really always vital and should physiotherapists automatically rely on it?.....	22
1.5 Keep/refer decision making abilities as part of the clinical decision making process for physiotherapists	24
1.6 Keep/refer decision making abilities as part of international guidelines for the physiotherapy profession and education	25
1.7 Keep/refer decision making abilities as part of national guidelines for the physiotherapy profession and education in Europe	27
1.7.1 Introduction	27
1.7.2 Methods.....	27
1.7.3 Results	28
1.7.4 Discussion and Conclusion.....	31
1.8 Keep/refer decision making abilities as part of guidelines for the physiotherapy profession and education in Austria	31
1.9 Overreaching aim and objectives of this thesis.....	32
1.10 Summary of chapter one	33

Chapter 2: Screening for serious medical conditions.

2.1 Introduction	35
2.2 Red Flags to screen for serious medical conditions	35
2.3 Measurements of validity of diagnostic/screening tests	37
2.4 Measurement of diagnostic validity in the clinical context of red flag screening	38
2.5 Clinical Prediction Rules to screen for serious medical conditions	41
2.6 Summary of chapter two	43

Chapter 3: Screening for serious medical conditions of the spine.

3.1 Introduction	44
3.2 Spinal metastatic disease	45
3.3 Spinal fracture	52
3.4 Spinal infection	56
3.4.1 Tuberculous spondylodiscitis/Spinal tuberculosis	58
3.5 Cauda Equina Syndrome	60
3.6 Critical discussion about the importance of screening for serious medical pathologies and problems with how it is performed and recommended in current guidelines	63
3.7 Possible implications for future screening alternatives	64
3.8 Summary of chapter three	69

Chapter 4: Keep/refer decision making abilities of physiotherapists and physiotherapy students.

4.1. Introduction	70
4.2. Overview of teaching methods for improving clinical reasoning and decision making competencies within health care related education	70
4.3. Clinical vignettes as a tool for measuring clinical decision making competencies of health professionals	73
4.4. Keep/refer decision making abilities of physiotherapists and physiotherapy students using clinical vignettes	75
4.5. Attitude of different stakeholders towards the importance of qualified physiotherapists and physiotherapy students to make accurate keep/refer decision and to recognise the presence of serious pathologies	83

4.6. What is already known and what are the gaps in the literature with special relevance for Austria?	85
4.7. Ethical approval.....	87
4.8. Summary of chapter four	88

Chapter 5: Keep/refer decision making abilities of Austrian final year undergraduate physiotherapy students within Europe: A cross sectional survey using clinical vignettes

5.1 Introduction	90
5.2 Methods	91
5.2.1 Study Design	91
5.2.1 Setting.....	91
5.2.3 Participants	91
5.2.4 Variables	92
5.2.5 Study/Sample size	92
5.2.6 Data sources/measurements.....	92
5.2.7 Survey and questionnaire pilot testing	94
5.2.8 Ethical considerations	94
5.2.9 Procedure	95
5.2.10 Quantitative variables	97
5.2.11 Statistical methods.....	97
5.2.12 Missing data	98
5.3 Results	98
5.3.1 Participants	98
5.3.2 Results for European undergraduate physiotherapy students	101
5.3.3 Results in relation to divergent access systems to physiotherapy within Europe	102
5.3.4 Results of individual ENPHE member countries	105
5.3.5 Results of the descriptive survey	107
5.4 Discussion	114
5.5 Limitations	121
5.6 Conclusion	125
5.7 Summary of chapter 5.....	127

Chapter 6: A cross sectional survey to explore the importance of keep/refer decision making within physiotherapy education and the profession from the perspective of medical doctors in Austria

6.1. Introduction	128
6.2. Methods	129
6.2.1. Research tool	129
6.2.2. Pilot testing	131
6.2.3. Sample selection	131
6.2.4. Survey administration	132
6.2.5. Ethical statement	132
6.3. Analysis	133
6.4. Results	134
6.4.1. Demographic characteristics/General question	134
6.4.2. Keep/refer decision making competencies and screening for serious pathologies as part of the physiotherapists' undergraduate and postgraduate education	135
6.4.3. Interdisciplinary cooperation between physiotherapists and physicians	139
6.5. Discussion	140
6.6. Strengths of the study	143
6.7. Limitations	144
6.8. Conclusion	145
6.9. Summary of chapter 6	146

Chapter 7: Evaluation of an educational intervention to improve the keep/refer decision making abilities of undergraduate physiotherapy students in Austria: a mixed methods randomised-pilot study.

7.1. Introduction	147
7.2. Background and study objectives	148
7.3. Methods	152
7.3.1. Study design.....	152
7.3.2. Study participants	152
7.3.3. Intervention	153

7.3.4. Outcomes	154
7.3.5. Pre-specified criteria	158
7.3.5.1. Definition of pre-specified criteria	158
7.3.5.2. Pre-specified criteria for the current study	158
7.3.6. Randomisation	159
7.3.7 Analytical methods.....	160
7.4. Results	161
7.4.1. Results of primary study objectives	161
7.4.1.1. Feasibility	161
7.4.1.2. Acceptability	164
7.4.2. Results of secondary study objectives	165
7.4.2.1. Difficulties with the completion of the clinical vignettes from the perspectives of students from the intervention and control group	165
7.4.2.2. How responding students think keep/refer decision making competencies can be improved?	168
7.4.2.3. Which parts of the lecture did students from the intervention group find beneficial for making keep/refer decisions based on clinical vignettes (and why)? ...	170
7.4.2.4. Was the lecture missing something which should be included in future lectures?.....	172
7.4.2.5. Potential effectiveness of the CBL educational intervention, missing data and completion rates	174
7.5. Discussion	175
7.6. Strengths.....	186
7.7. Limitations	187
7.8. Conclusion	189
7.9. Summary of chapter 7	190

Chapter 8: Discussion and conclusion.

8.1. Introduction	191
8.2. Deficiencies in current undergraduate training in Austria to recognise serious pathologies	193

8.3. Progression towards RCT for testing improved undergraduate training to recognise serious pathologies	197
8.4. Conclusion	199

Chapter 9: Recommendations for future research and education.

9.1. Introduction	201
9.2. Recommendations for addressing the existing deficiencies in current undergraduate training in Austria to recognise serious pathologies	201
9.3. Recommendations for future testing improved undergraduate training to recognise serious pathologies	204
References.....	208
Appendices.....	242

Acknowledgements

I would explicitly like to thank my supervisory team which consisted of Prof James Selfe, Dr Jessie Janssen and Dr Hazel Roddam for their patience, their supportive and engaging manner throughout this PhD journey and, in particular, for their valuable and continuous feedback which helped to form this thesis. You three are such a great supervisory team as a PhD student could only wish for.

Dissemination

Published papers in peer-reviewed journals:

Lackenbauer, W., Janssen, J., Roddam, H. and Selfe, J. (2017) 'Is keep/refer decision making an integral part of national guidelines for the physiotherapy profession within Europe? A review.' *Physiotherapy*, 103(4) pp.352-360 DOI: 10.1016/j.physio.2016.11.005 (Appendix 31)

Lackenbauer, W., Janssen, J., Roddam, H. and Selfe, J. (2018) 'Keep/refer decision making abilities of European final year undergraduate physiotherapy students: a cross-sectional survey using clinical vignettes.' *European Journal of Physiotherapy*, 20(3) pp. 128-134 <https://doi.org/10.1080/21679169.2017.1408682> (Appendix 32)

Lackenbauer, W., Janssen, J., Roddam, H. and Selfe, J. (2019) 'Keep/refer-decision-making abilities and screening for serious pathologies as integral components of physiotherapy education and profession: The perspective of Austrian physicians.' *Physioscience*, 15(1) pp.28-36 DOI: 10.1055/a-0833-1759 (Appendix 33)

Lackenbauer, W., Janssen, J., Roddam, H. and Selfe, J. 'Evaluation of the feasibility, acceptability and potential effectiveness of an educational intervention which aims to improve the keep/refer decision making abilities of Austrian undergraduate physiotherapy students: A randomised pilot study. *International Journal of Therapy and Rehabilitation* (Accepted for publication) (Appendix 34)

Poster presentations on research conferences:

'A cross-sectional survey using clinical vignettes to explore keep/refer decision making abilities of European final year undergraduate physiotherapy students.' Practitioner wellbeing and self-care conference 14th of June 2018 at the Faculty of Health, Psychology and Social Care at Manchester Metropolitan University/UK.

‘A cross-sectional survey using clinical vignettes to explore keep/refer decision making abilities of European final year undergraduate physiotherapy students.’ Faculty Research In High Summer Conference (FRIHSC) 09.07-10.07. 2018 at Manchester Metropolitan University/UK Faculty of Health, Psychology and Social Care.

‘A cross-sectional survey using clinical vignettes to explore keep/refer decision making abilities of European final year undergraduate physiotherapy students.’ From Research to Practice: Across Nursing, Midwifery and Health Sciences 20th of September 2018 at the Hochschule für Gesundheit Bochum/Germany.

‘Evaluation of an educational intervention to improve the keep/refer decision making competencies of Austrian undergraduate physiotherapy students.’ World Confederation of Physical Therapy Conference in Geneva/Switzerland 10-13 May 2019.

List of Appendices

Appendix 1: Clinical prediction rules to rule out fractures of the foot/ankle, knee joint, cervical spine and proximal deep venous thrombosis	242
Appendix 2: Ethical approval from the Manchester Metropolitan University Ethics Committee 1390 (Faculty of Health, Psychology and Social Care).....	247
Appendix 3: Ethical approval from the University of central Lancashire Ethics Committee STEMH 435 (School of Health Sciences)	248
Appendix 4: Permission to conduct research from Lahti University of Applied Sciences	249
Appendix 5: Permission to conduct research from Satakunta University of Applied Sciences	250
Appendix 6: Permission to conduct research from Tampere University of Applied Sciences	252
Appendix 7: Initial e-mail which was sent to ENPHE member institutions	253
Appendix 8: The 12 vignettes from chapter five	254
Appendix 9: Additional questionnaire for Austrian students from chapter 5	255
Appendix 10: Study information sheet for Austrian students studying at ENPHE member institutions	258
Appendix 11: Study information sheet for international students studying at ENPHE member institutions	261
Appendix 12: E-mail correspondence with ENPHE member institutions	264
Appendix 13: E-mail correspondence with ENPHE member institutions	265
Appendix 14: E-mail correspondence with ENPHE member institutions	265
Appendix 15: E-mail correspondence with ENPHE member institutions	266
Appendix 16: Identical answers by students from one ENPHE member country	267
Appendix 17: Feedback example from supervisory team	268
Appendix 18: Final version of the questionnaire for Austrian medical doctors after feedback from the supervisory team	270
Appendix 19: Final (amended) version of the questionnaire for Austrian medical doctors after feedback from volunteering Austrian medical doctors	272
Appendix 20: Study description for medical doctors in Austria.....	274

Appendix 21: Information sheet for prospective study participants	277
Appendix 22: Informed consent form for participating students	280
Appendix 23: CBL educational intervention.....	284
Appendix 24: Supplementary questionnaire for all student.....	294
Appendix 25: 11 validated vignettes from chapter seven	296
Appendix 26: Slips of paper for the randomisation process.....	297
Appendix 27: Raw data for the question: What did you personally find most difficult when making a keep/refer decision (and can you tell us why)?	298
Appendix 28: Raw data for the following question: How do you personally think can keep/refer decision making abilities be improved?	304
Appendix 29: Raw data for the following question: Which part(s) of the additional lecture did you personally find most beneficial to help you to make an accurate keep/refer decision (based on the 11 vignettes)? Please tell us why	310
Appendix 30: Raw data for the following question: Do you personally feel that the lecture was lacking something (which should be included in future lectures)?	313
Appendix 31: Abstract of the published paper	316
Appendix 32: Abstract of the published paper	317
Appendix 33: Abstract of the published paper	318
Appendix 34: Journal editor's letter of acceptance for publication.....	319

List of Tables

Table 1.1: Five reasons why all physiotherapists need to screen their patients for the presence of a more severe medical condition	25
Table 1.2: Overview of in how far different European countries have included keep/refer decisions into their own national guidelines (used with permission)	29
Table 2.1: Examples of different “flags” within the literature (used with permission)	36
Table 2.2: 2×2 contingency table for calculating the accuracy of a diagnostic (used with permission).....	38
Table 2.3: Measures of diagnostic accuracy (used with permission)	38
Table 2.4: Diagnostic properties of single red flag items for the detection/exclusion of spinal metastatic cancer	40
Table 3.1: Diagnostic accuracy of individual red flags for the identification/exclusion of fractures of the spine (used with permission)	52
Table 3.2: Diagnostic validity with several cut off points to rule in/out spinal fractures (used with permission).....	53
Table 3.3: Diagnostic accuracy of clinical prediction rule (used with permission)	54
Table 3.4: Diagnostic accuracy of clinical prediction rule to rule in/out vertebral fractures in tertiary care (used with permission).....	55
Table 3.5: Ten risk factors which increase the possibility of suffering from a spinal infection (used with permission)	57
Table 3.6: Calculation of SIRCH score to identify/exclude spinal infections (used with permission).....	57
Table 4.1: Summary of studies which examined keep/refer decision making abilities of qualified physiotherapists and physiotherapy students.	76
Table 5.1: Demographic characteristics of participating ENPHE member countries ...	100
Table 5.2: Mean and median percentages of correct keep/refer decisions of European undergraduate physiotherapy students combined for each category.....	101
Table 5.3: Number and percentages of students who made a correct keep/refer decision for 100% of cases within a category	102

Table 5.4: Mean and median percentages of correct keep/refer decisions (depending on access system to physiotherapy) for each category	103
Table 5.5: Mean and median percentages of correct keep/refer decisions for each category (per country).....	104
Table 5.6: Percentage and actual number of students (per country) who made a correct (Yes) or incorrect (No) keep/refer decision for 100% of cases within a category	106
Table 5.7: Results of current study compared to previous research which used the same vignettes.....	126
Table 7.1: Mean and median percentages of correct keep/refer decisions for the musculoskeletal, medical non-critical and medical critical vignettes for the intervention and control group	174
Table 7.2: Percentages of students from the intervention and control group who made a correct keep/refer decision for 100% of cases within each category.....	175

List of Figures

Figure 2.1: The three main developmental steps of a clinical prediction rule (permission obtained)	42
Figure 5.1: Different stages of recruitment	99
Figure 5.2: Questions concerning the students' experience with (the completion of) the 12 vignettes	108
Figure 5.3: Questions concerning the undergraduate education plus clinical placements	109
Figure 5.4: Questions concerning the physiotherapeutic profession in general	113
Figure 5.5: Percentage of students who made a correct keep/refer decision for vignette number two	117
Figure 5.6: Percentage of correct keep/refer decisions for individual countries for vignette number five	118
Figure 5.7: Percentage of correct keep/refer decisions for individual countries for vignette number nine	119
Figure 5.8: Percentage of students who made a correct keep/refer decision for vignette number 10	120
Figure 6.1: Demographic characteristics of participating general practitioners (n=76) and orthopaedic surgeons (n=40)	134
Figure 6.2: Questions concerning the physiotherapy under-and postgraduate education in Austria from the perspective of participating general practitioners (n=76) and orthopaedic surgeons (n=40)	135
Figure 6.3: Questions regarding the general practitioners' and orthopaedic surgeons' everyday work	139
Figure 7.1: Flow diagram for the mixed methods pilot study	163

Figure 7.2: Students from the intervention opinion on self-perceived effectiveness of the educational intervention	164
Figure 7.3: Students from the intervention group rating on burden	165
Figure 7.4: Number of students from the intervention and control group who rated their self-experienced level of difficulty when completing the clinical vignettes	166
Figure 7.5: What students from both groups found difficult when completing the clinical vignettes	167
Figure 7.6: How keep/refer decision making abilities can be improved from the perspective of responding students	169
Figure 7.7: Which parts of the lecture were deemed beneficial for completing the clinical cases	170
Figure 7.8: Benefit of certain parts of the lecture for making keep/refer decisions based on clinical vignettes	171
Figure 7.9: Which elements should be included into future lectures	173
Figure 7.10: Number of students from each group who made a correct decision (refer without physiotherapy) for case number one.....	182
Figure 7.11: Number of students from each group who made a correct decision (refer without physiotherapy) for case number four	183
Figure 7.12: Number of students from each group who made a correct decision (refer without physiotherapy) for case number six	184
Figure 7.13: Number of students from each group who made a correct decision (refer without physiotherapy) for case number seven	185
Figure Appendix 1.1.1: Ottawa ankle rule (used with permission)	242
Figure Appendix 1.1.2: Ottawa knee rule (used with permission)	243
Figure Appendix 1.1.3: Canadien C-Spine rule (no permission required)	244

Figure Appendix 1.1.4: Wells Score (used with permission).....	245
--	-----

Chapter One

Background and Research Context

1.1 Introduction and structure of the thesis

This thesis was initiated in the light of developments within the Austrian health care sector with physiotherapists being included for the first time as part of the planning for how the national health care system should be developed (Physio Austria, 2014). In addition, there is an ongoing effort from the Austrian physiotherapy association to implement a direct access system to physiotherapy in Austria (Baumgartner, 2013; Bauer-Horvath, 2015; Sorge, 2017). Opponents of direct access to physiotherapy services primarily express concern that physiotherapists might fail to recognize the presence of serious medical conditions, which require medical evaluation and/or treatment (Deyle, 2006; Jette et al., 2006; Leemrijse et al., 2008; Foster et al., 2012; Shoemaker, 2012; Piano et al., 2017).

Working in a direct access setting entails a high level of responsibility. The Austrian physiotherapy association's ongoing desire for more practice autonomy warrants the development of an evidence based curriculum that properly prepares Austrian physiotherapy students and newly qualified physiotherapists to make accurate and autonomous keep/refer decisions and recognise the presence of serious pathologies which require a referral to a physician.

This thesis consists of nine individual chapters which will be briefly described below:

- **Chapter One** is an introductory chapter that outlines the research background and contains the overarching aim and objectives of this thesis.
- **Chapter Two** provides an overview on how clinicians can screen patients for the presence of serious pathologies. This is being followed by a discussion on the diagnostic performance and proper use of red flags in general.
- **Chapter Three** reviews the literature for the current level of evidence to detect/exclude the presence of serious pathologies primarily of the spine.
- **Chapter Four** reviews the literature in order to answer the following questions:

- a) Which educational strategies are scientifically supported to improve clinical decision making competencies within health care related education?
- b) Which research methods can be utilized to examine clinical decision making competencies within health care related research?
- c) Which studies have already been done to assess the competency of qualified physiotherapists and physiotherapy students to detect the presence of serious pathologies?
- d) Has the attitude of different stakeholders (e.g. qualified physiotherapists, physiotherapy students, medical doctors) towards the importance of physiotherapists and physiotherapy students to recognise serious pathologies already been assessed?

● **Chapter Five** reports a cross sectional survey that assesses the keep/refer decision making abilities of Austrian final year undergraduate physiotherapy students based on clinical vignettes within Europe. In addition, this study tried to get insight into the opinion and attitude of Austrian undergraduate physiotherapy students towards independent keep/refer decisions and the recognition of serious pathologies as part of the physiotherapy education and profession in Austria.

● **Chapter Six** aims at getting insight into the opinion and attitude of Austrian medical doctors towards independent keep/refer decisions and the recognition of serious pathologies as part of the physiotherapy education and profession in Austria. Moreover, chapter six is designed to get insight into the opinion of Austrian medical doctors which clinical examination procedures Austrian physiotherapy students and qualified physiotherapists should be capable of.

● **Chapter Seven** presents a mixed methods randomised pilot study with the primary aim to assess the feasibility and acceptability of a study protocol for a future definitive randomised controlled trial (RCT). This mixed methods randomised pilot study also aims to assess the potential effectiveness of a CBL educational intervention on the keep/refer decision making competencies of Austrian final year undergraduate physiotherapy student based on clinical vignettes.

● **Chapter Eight** summarises and discusses the findings of this thesis in the context of existing literature.

● **Chapter Nine** provides recommendations for future education and research for keep/refer decision making and the recognition of serious pathologies for undergraduate physiotherapy curricula in Austria.

1.2 Physiotherapy as a profession within the health care system: A definition by the World Confederation of Physical Therapy (WCPT).

Physiotherapists are widely acknowledged as specialists for movement based interventions in order to restore mobility ‘... where movement and function are threatened by ageing, injury, pain, diseases, disorders, conditions or environmental factors ...’(WCPT, 2017:online). A central part of the physiotherapists’ work is a comprehensive evaluation and assessment of patients and to determine what kind of intervention will result in the optimum outcome. Furthermore, as members of the general healthcare community, physiotherapists are also advised to know their own limits of knowledge and expertise and work within their scope of practice.

Physiotherapists are required to work closely together with other health care professionals (e.g. medical practitioners) and seek their assistance and specialised knowledge in the case where physiotherapists deem a patient’s condition not suitable for physiotherapy management (WCPT, 2011).

1.3 Direct access to physiotherapy service: Risk for patients or advantageous for the health care system?

There are two ways a patient can access physiotherapy: Direct and indirect. In a health care system, where physiotherapists act as first contact practitioners (direct access), patients can refer themselves directly to a physiotherapist without being referred by another health care professional (e.g. a by physician) (Goodman and Snyder, 2013). On the other hand, in some countries, patients require a medical referral before they can consult a physiotherapist (WCPT, 2011; Ojha et al., 2014). While proponents of direct access to physiotherapy argue with the potential benefits of lower costs for the health

care system (Desmeules et al., 2012; Piscitelli et al., 2018; Denninger et al., 2018; Bornhöft et al., 2019; Torjesen, 2019) and decreased work load for general practitioners (Bostock, 2016; Downie et al., 2019; Torjesen, 2019), opponents of direct access to physiotherapy services primarily express concern that physiotherapists might fail to recognize the presence of serious medical conditions, which require medical evaluation and/or treatment (Deyle, 2006; Jette et al., 2006; Leemrijse et al., 2008; Foster et al., 2012; Shoemaker, 2012; Piano et al., 2017).

Due to a high prevalence of orthopaedic and musculoskeletal pain disorders in the general population (Department of Health, 2006; Troestrup et al., 2017; Marks et al., 2017) a heightened research interest on enhanced practice autonomy for physiotherapists has been in the field of musculoskeletal medicine (Lebec and Jogodka, 2009; Desmeules et al., 2012; Ojha et al., 2014; Scheele et al., 2014; Marks et al., 2017; Piano et al., 2017). While it is acknowledged that direct access to physiotherapy/enhanced practice autonomy for physiotherapists is desirable for all medical areas of expertise, this thesis solely focuses on the musculoskeletal field. Hence, the terminology direct access or increased/enhanced practice autonomy will exclusively be used in the context of musculoskeletal medicine.

1.4 The physician's referral: Is it really always vital and should physiotherapists automatically rely on it?

A retrospective analysis in 2005 of physicians' referrals to physiotherapists in the United States revealed that the majority of referral diagnoses (e.g. low back pain, back sprain) were not particularly helpful for the physiotherapist's decision making process regarding treatment options and/or appropriateness of physiotherapy intervention in general (Davenport et al., 2005). While Davenport et al. (2005) acknowledge that it is not always possible to describe a distinct pathological process or identify a specific structural pathology and therefore provide a specific diagnosis for all pain problems of the neuro-musculoskeletal system (e.g. nonspecific chronic low back pain, shoulder impingement syndrome) (O'Sullivan, 2005; Lewis, 2011), a benign cause should never, solely based on the physician's referral, be automatically taken for granted (Davenport et al., 2005). As a direct consequence, the authors suggest that physiotherapists should continuously

challenge the appropriateness of the physicians' referrals and whether a patient's condition seems suitable for physiotherapy management (Davenport et al., 2005).

Liu and Flechter (2006) reported similar results when they evaluated 544 physicians' referrals to physiotherapy in the United States. One third of the medical prescriptions (177 out of 544) either contained pure descriptions of the patients' symptoms (e.g. weakness, dizziness) or gave rather vague, nonspecific descriptions of the patients' symptoms location(s) (e.g. knee, hip or back pain) which, again, are not particularly informative concerning underlying mechanisms and causes of the patients' ailment(s). Liu and Fletcher (2006) warn physiotherapists not to solely rely on the physician's referral. The authors conclude that physiotherapists are required to independently examine their patients in order to find the reason(s) for their health problem(s) (Liu and Fletcher, 2006).

In line with this, a review by Boissonnault and Ross (2012) of 78 published case reports and case series demonstrated that multiple screening strategies performed by physiotherapists and subsequent referral to a physician finally led to the diagnosis of a wide range of conditions (e.g. spinal metastatic cancer, spinal infection, spinal osteoporotic fracture, various visceral diseases) as underlying cause(s) of patients' pain complaints. While only a small number of patients consulted a physiotherapist without being referred by a physician, the majority (74.4 %) had undergone prior medical examination. In conclusion, even when a patient has already been examined and subsequently referred by a medical professional, the presence of a serious pathology which might mimic a benign musculoskeletal pain syndrome can never be automatically excluded (Boissonnault and Ross, 2012).

All studies within section 1.3 were conducted in the United States and there is unfortunately no similar data available for European countries. Yet, these studies provide a solid rationale why all physiotherapists, even when their patients have already been evaluated and referred by a medical professional, should routinely assess their patients for possible underlying serious medical diseases.

While it is clear that the physiotherapists' traditional role is not to diagnose a specific pathological process (e.g. lung cancer, prostate cancer) as an underlying reason of

patients' health issues (Donato et al., 2004; Boissonnault, 2011), physiotherapists, as part of their clinical reasoning process, must be independently capable of determining whether a patient seems suitable for physiotherapy (keep), or not (refer) (Jones, 1992). McAllister et al. (2017) refrained from using the word diagnosis for their decision model for suspected axial spondyloarthritis. Instead, the authors adopted the terminology referral criterion, which is probably more appropriate as the final diagnosis will be eventually made by other health professionals (e.g. medical doctors) (McAllister et al., 2017). In this context, Vaughn et al. (2011) introduced the term keep/refer decision making abilities which will be used throughout this thesis.

1.5 Keep/refer decision making abilities as part of the clinical decision making process for physiotherapists.

Recognition of serious pathologies, especially in their early stages, is a major challenge for all clinicians (Greenhalgh and Selfe, 2003; Greenhalgh and Selfe, 2009). Despite the fact that the prevalence of serious pathologies which mimic neuro-musculoskeletal pain syndromes is reported to be low (Henschke et al., 2009; Enthoven et al., 2016; de Schepper et al., 2016; Premkumar et al., 2018; Reito et al., 2018; Galliker et al 2019), physiotherapists, when using proper screening strategies, can become critical when it comes to recognising a wide range of various disorders where medical attention is necessary (Boissonnault and Ross, 2012; Wahl et al., 2013; Heick et al., 2013; Mabry et al., 2014; Smith et al., 2014; Lackenbauer and Janssen, 2016; Lackenbauer and Janssen, 2017; Lackenbauer, 2018; Lackenbauer, 2019).

Therefore, it seems only logical that qualified physiotherapists and physiotherapy students have the appropriate level of competence which enables them to make an autonomous decision about the appropriateness of physiotherapy (Boissonnault and Bass, 1991; Davenport et al., 2005; Ross and Boissonnault, 2010; Goodman and Snyder, 2013). As shown in table 1.1, Goodman and Snyder (2013) give valid reasons why every physiotherapist should be capable of making an accurate decision if a patient's condition seems suitable for physiotherapy.

Table 1.1: Five reasons why all physiotherapists need to screen their patients for the presence of a more severe medical condition (Goodman and Snyder 2013:3)

- '1) Clients may obtain a signed prescription for physical therapy based on similar past complaints of musculoskeletal symptoms without direct physician contact.
- 2) Medical specialization: Medical specialists may fail to recognize underlying systemic disease.
- 3) Disease progression: Early signs and symptoms are difficult to recognize, or symptoms may not be present at the time of medical examination.
- 4) Patient/client disclosure: Client discloses information previously unknown or undisclosed to the physician.
- 5) Client does not report symptoms or concerns to the physician because of forgetfulness, fear, or embarrassment.'

1.6 Keep/refer decision making abilities as part of international guidelines for the physiotherapy profession and education.

Acknowledging the importance for physiotherapists to independently screen their patients for the presence of serious medical conditions, the World Confederation of Physical Therapists (WCPT) Guidelines for Standards of Physical Therapy Practice (2011:14) state:

where the examination, diagnostic process, or any change in status reveals findings outside the scope of knowledge, experience, and/or expertise of the physiotherapist, the patient/client shall be so informed and referred to the appropriate professional.

Moreover, the WCPT guideline for physical therapist professional entry level education (WCPT, 2011) specifically demand that a comprehensive review of various body systems (cardiovascular, pulmonary, musculoskeletal, neuromuscular, integumentary) has to be carried out as part of the patient's assessment. Again, it is explicitly described that

physiotherapists should know exactly when a referral to another health care professional (e.g. a physician) is warranted (WCPT, 2011). Furthermore the European Core Standards of Physiotherapy Practice clearly demand that every physiotherapist should be capable of carrying out a risk assessment prior to each treatment for every patient (ER-WCPT, 2008). In this context, the European Core Standards of Physiotherapy Practice (ER-WCPT, 2008) directly refer to the WCPT Declaration of Principle (2007:4):

when the diagnosis is not clear or the required intervention/treatment is beyond the capacity of the physical therapist, the physical therapist shall inform the patient/client and provide assistance to facilitate a referral to other qualified persons.

Furthermore, the WCPT Declaration of Principle (WCPT, 2007:4) highlights:

physical therapists will consult with the referring medical practitioner if the treatment programme or a continuation of the programme is not in accord with the judgement of the physical therapist.

Moreover, the WCPT policy statement for education (2011:1) points out:

that any programme, irrespective of its length and mode of delivery, should deliver a curriculum that will enable physical therapists to attain the knowledge, skills and attributes described in the guidelines for physical therapist professional entry level education.

1.7 Keep/refer decision making abilities as part of national guidelines for the physiotherapy profession and education in Europe.

1.7.1 Introduction

Despite the fact that the professional guidelines published by the WCPT (2011) and its European branch (ER-WCPT, 2008) clearly deem keep/refer decision making abilities to be important, it was not clear whether this is also reflected in individual national guidelines for the physiotherapy profession of various European countries that are also member associations of the European Network of Physiotherapy in Higher Education (ENPHE). Therefore, a literature search was conducted with the aim to analyse if and in how far keep/refer decision making abilities are an integral part of all professional physiotherapy guidelines of ENPHE member associations. The reason to target ENPHE member associations for this study was because ENPHE (ENPHE, 2018:online) is committed to:

encourage and support standards of high quality education in physiotherapy in accordance with the recommendations of the World Confederation for Physical Therapy (WCPT and ER-WCPT).

Hence, it was assumed that making independent keep/refer decisions would be represented in professional guidelines of ENPHE member associations specifically and in detail as this is the case in the WCPT guidelines (WCPT, 2011).

[Section 1.6 has been published in the peer-reviewed journal Physiotherapy. The abstract is attached as Appendix 31 on page 316 of this thesis. The complete version of the published paper is available online under the following link: DOI: 10.1016/j.physio.2016.11.005].

1.7.2 Methods

In order to collect national guidelines of ENPHE member countries, medical databases (Medline, Web of Science, CINAHL, ProQuest and EMBASE) were initially searched using the terms “national guidelines”, “standards of practice”, “competency guidelines” or “professional profile”. These terms were used in combination with either “physiotherapy” or “physical therapy” together with the country of interest.

Furthermore, the grey literature (via Google, YAHOO and BING) was also searched using the same search terms. At the same time, 25 national physiotherapy associations of ENPHE member countries were contacted (via e-mail) several times between 23/12/15 and 19/02/16 with a formal request to send their national guidelines (preferably an English language version if one existed). If, however, no English or German version was available, Google translator was used to translate the documents into English.

Of interest were text passages that described the physiotherapists' professional obligation to make an accurate and independent decision to either keep or refer a patient to a medical professional. If, however, keep/refer decision making abilities were not explicitly mentioned, text passages that demanded close collaboration with the referring medical/other health care professionals and/or feedback in the case of any unusual events that might occur during the examination and/or develop during the course of the therapy were also deemed relevant.

1.7.3. Results

As seen in table 1.2, numerous European countries (e.g. Belgium, Denmark, Italy, Ireland, the Netherlands, the United Kingdom) have already included keep/refer decision making abilities in their national guidelines for the physiotherapy profession. Yet, there are still a few countries in Europe (Austria, Czech Republic, Germany, Lithuania, Norway, Switzerland) that do not seem to regard keep/refer decision making abilities (as described in the WCPT guidelines) as vital part of their national guidelines.

Table 1.2: Overview of in how far different European countries have included keep/refer decisions into their own national guidelines (Lackenbauer et al., 2017) Permission obtained.

[Please refer to the following pages]

ENPHE Member Association	Professional Guideline (Original Title)	Relevant Keep/Refer statement (English translation)	Guideline date	Native language version (YES/NO)	Direct translation of ER-WCPT guideline (YES/NO)	Direct access to physiotherapy (YES/NO)	Differentiated regulations for generalist specialist (YES/NO)	for versus grades
Denmark	Etiske retningslinjer for Danske Fysioterapeuter	Physiotherapists refer patients to colleagues or other health professionals when the limit of own area of competence has been reached and it is estimated that other competencies are necessary to ensure optimal patient care. (p.5)	Unknown	YES	NO	YES (but only for the private sector)	NO	
Norway	RAMMEPLAN FOR FYSIOTERAPEUTTUTDANNING	Physiotherapist program shall be in accordance with national and international health education policy guidelines (p.4).	2004	YES	NO	YES (but only for the private sector)	NO	
Lithuania	Descriptor of the study field of Rehabilitation	Take an independent decision in a difficult situation that requires innovative (holistic) approach (17.4.2.)	2015	YES	NO	YES (but only for the private sector)	NO	
Belgium	Beroeps-Competentieprofiel van de kinesitherapeut in België	Depending on the results of the first screening and taking the findings in the clinical examination the physiotherapist, in consultation with the patient, decides to set in treatment, give the necessary advice or refer to another health care provider. (p.18)	2010	YES	NO	NO	NO	
Germany	Berufsrordnung des deutschen Verbandes für Physiotherapie	If any peculiarities during the examination or the course of the treatment occur, consult with the referring medical practitioner if deemed necessary (p.2).	Unknown	YES	NO	NO	NO	
Ireland	Therapy Project Office: Physiotherapy Competencies	Graduate Entry level: "Recognizing own limitations and liaising with senior staff and other team members when appropriate." (p. 11) Senior competencies and Clinical Specialist: "Recognizing when it is appropriate to refer decisions to a higher level of authority and include colleagues in the decision making process." (p. 13 and p. 16)	2008	YES	NO	YES (but only for the private sector)	YES	
The Netherlands	The professional profile of the physical therapist	Depending on the results of the first screening and the findings from the physiotherapeutic evaluation, the physical therapist makes decision in consultation with the patient with regard to the treatment to be started, advice or referral " In direct access, the physical therapist determines in the first screening whether further physiotherapeutic	2006	NO	NO	YES (but only for the private sector)	NO	

		analysis is useful. Depending on the outcomes, diagnostic physiotherapeutic evaluation is subsequently done or the patient is referred. " (p.17)					
Austria	Berufsbild Physiotherapie. MTD Ausbildungsverordnung. Physiotherapeuten in Primary Health Care- best point of service.	<u>Primary Health Care:</u> Communication with other health care providers. Screening what kind of or whether movement based intervention is indicated. <u>MTD Ausbildungsverordnung:</u> 4. Recognize authority/competence of other medical/health care professions. <u>Berufsbild:</u> Independently assess if referral by medical practitioner is suitable from the perspective of the physiotherapy profession (p. 20); Especially important in the event of changes in the patient's health status (p.21).	2004 2006 2014	YES YES YES	NO	NO	NO
United Kingdom	Standards of Proficiency	"Registrant physiotherapists must know the limits of their practice and when to seek advice or refer to another professional." (p. 7)	2013	YES	NO	YES	NO
Italy	LA FORMAZIONE "CORE" DEL FISIOTERAPISTA	Refer the patient to another (health care) professional when their activity is required and when the situation is beyond the therapists professional and / or experience and/or competence (page. 72).	2013	YES	NO	YES (but only for the private sector)	NO
Slovenia	European Standards of Core of physiotherapy practice (Slovenian translation)	Refer to original document	2008	No	Yes	YES (but only for the private sector)	No
Switzerland	Berufsbild Physiotherapie. Berufsordnung des Schweizer Physiotherapie Verbandes	Berufsordnung des Schweizer Verbandes: Inform referring doctor about course of the treatment and treatment outcome (p. 3). Promote interdisciplinary collaboration within various health professions (p. 3).	2009 2013	Yes	NO	NO	NO
Czech Republic	European Physiotherapy Service Standards	/	2003	NO	YES	YES (but only for the private sector)	NO

1.7.4. Discussion and Conclusion

This study was the first to assess whether keep/refer decision making abilities are specifically mentioned in the national guidelines of European countries which are also a member organisation of the ENPHE. Despite the fact that these specific abilities are undoubtedly an important part of the physiotherapeutic decision making process, they are not explicitly mentioned in all national guidelines that were reviewed. Even though international guidelines (ER-WCPT 2008; WCPT, 2011) clearly deem making independent keep/refer decisions to be crucial for every physiotherapist, those abilities are not included as a specific requirement in all guidelines that were reviewed. Despite the clear description of those abilities in the WCPT guidelines (WCPT 2011) which are prescriptive and leave no room for interpretation, most countries have made some amendments for their own guidelines.

1.8 Keep/refer decision making abilities as part of guidelines for the physiotherapy profession and education in Austria.

In the current Austrian guideline for the physiotherapy profession, the Berufsprofil (Physio Austria, 2004), it is only mentioned that physiotherapists should recognize the appropriateness of the physician's referral from the perspective of the physiotherapy profession. Even though this can be regarded as a vague/cautious suggestion that physiotherapists should at least consider the possibility that the patient's condition might not be suitable for physiotherapy intervention, a clear description as in the WCPT guidelines (WCPT, 2011) and its ethical principles (WCPT, 2007) is missing.

Although the Austrian Standards of Physiotherapy Education (FH-MTD 2006) recognise the importance of the identification of contraindications for individual physiotherapeutic intervention(s) and that physiotherapists should recognize if the management of other health professionals is indicated, teaching keep/refer decision making abilities is currently not a mandatory part of the Austrian undergraduate physiotherapy curriculum.

Another document describes the future role of physiotherapists as part of a primary health care system (PHC) (Physio Austria, 2014). This paper demands a close collaboration between different health care professionals and insists that physiotherapists need to evaluate their patients about the appropriateness for a movement based intervention (Physio Austria, 2014).

A more recent document from January 2016 which was up-dated in June 2017 describes the mandatory learning outcomes for Austrian physiotherapy students after the bachelor degree in the case of direct access to physiotherapy (Eckler et al., 2017). The background to this is an ongoing discussion about the implementation of a direct access system to physiotherapy in Austria (Baumgartner, 2013; Bauer-Horvath, 2015; Sorge, 2017). Within this document, it is clearly and explicitly stated that new graduates in the case of direct access need to be able to screen patients for the presence of serious pathologies which require a medical referral (Eckler et al., 2017).

[It needs to be stated that it is currently uncertain when direct access to physiotherapy in Austria will be implemented (Physio Austria, 2017). For comparison, to implement direct access to physiotherapy in the Netherlands required a 10 year discussion period and additional three years of an introductory phase. A similar time frame is considered realistic for Austria (Physio Austria, 2017).]

1.9. Overreaching aim and objectives of this thesis.

In light of recent developments within the Austrian health care sector (Physio Austria, 2014) and the ongoing desire from the Austrian physiotherapy association to implement a direct access system to physiotherapy (Baumgartner, 2013; Bauer-Horvath, 2015; Sorge, 2017) the aim and objectives of this thesis are as follows:

Aim:

The overreaching aim of this thesis is to provide recommendations for keep/refer decision making and the identification of serious pathologies for undergraduate physiotherapy curricula in Austria (chapter 9).

Objectives:

- I. A comprehensive literature search reports the current level of evidence to detect/exclude serious pathologies of the spine (chapter 3).
- II. A cross-sectional study (quantitative data) using clinical vignettes assesses the current level of keep/refer decision making competencies of Austrian final year undergraduate physiotherapy students within Europe (chapter 5).
- III. Using web-based-surveys (quantitative data) to get insight into the opinion and attitude of Austrian undergraduate physiotherapy students towards independent keep/refer decisions and the recognition of serious pathologies as part of the physiotherapy education and profession in Austria (chapter 5).
- IV. Using web-based-surveys (quantitative data) to get insight into the opinion and attitude of Austrian medical doctors towards independent keep/refer decisions and the recognition of serious pathologies as part of the physiotherapy education and profession in Austria (chapter 6).
- V. Using web-based surveys (quantitative data) to get insight into the opinion of Austrian medical doctors which clinical examination procedures Austrian physiotherapy students and qualified physiotherapists should be capable of (chapter 6).
- VI. To evaluate (quantitative and qualitative data) the feasibility and acceptability of a study protocol for a future definitive randomised controlled trial (RCT). This mixed methods randomised pilot study also aims to assess the potential effectiveness of a CBL educational intervention on the keep/refer decision making competencies of Austrian final year undergraduate physiotherapy student based on clinical vignettes (chapter 7).

1.10. Summary of chapter one.

- All physiotherapists and physiotherapy students need to have the appropriate knowledge and education to independently determine when a patient's condition is not suitable for physiotherapy intervention and when a referral to another health care professional (e.g. a physician) is needed.

- Although it is not uncommon that patients have had prior medical examination, research indicates that it is not advisable for physiotherapists to solely rely on the appropriateness of the medical referral.
- Several European countries have included specific reference to keep/refer decision making abilities in their guidelines for the physiotherapy education and profession.
- There is an ongoing discussion about the implementation of direct access to physiotherapy in Austria. This warrants fundamental changes within the undergraduate curriculum. In preparation to direct access, recent changes within the mandatory learning outcomes require new graduates to be able to recognise the presence of serious pathologies within a patient's clinical presentation.
- Recent changes within the Austrian health care sector and an ongoing discussion about the implementation of direct access to physiotherapy in Austria have led to the formulation of the aim and objectives of this thesis.

Chapter Two

Screening for serious medical conditions

2.1. Introduction

Chapter one highlighted the importance of physiotherapists being able to independently recognise the presence of serious pathologies which are not suitable for physiotherapy. In the context of Austria, the Austrian physiotherapy association seeks to implement a direct access system to physiotherapy (Baumgartner, 2013; Bauer-Horvath, 2015; Sorge, 2017). This has already led to changes within the mandatory learning outcomes which require new graduates, in the case of direct access, to be able to independently recognise the presence of serious pathologies and the need for medical evaluation (Eckler et al., 2017).

Chapter two will review existing literature in order to answer the following question:

- How can clinicians screen patients for the presence of serious pathologies? This is being followed by a discussion on the diagnostic performance and proper use of red flags in general.

2.2. Red Flags to screen for serious medical conditions.

According to the National Screening Committee of the United Kingdom (1998:12), screening is 'the systematic application of a test or inquiry, to identify individuals at sufficient risk of a specific disorder to warrant further investigation ...'. Furthermore, the National Screening Committee of the United Kingdom (1998) describes opportunistic screening which it defined as '... the offer of a test for an unsuspected disorder at a time when a person presents to the doctor [or in the context of this thesis: the physiotherapist] for another reason' (National Screening Committee, 1998:12). For example, in the case of a patient who seeks advice from a physiotherapist due to back complaints, the physiotherapist will look for certain clinical warning signs, i.e. red flags, to determine if the patient's pain may be caused by a more serious medical pathology. The idea of red flags is that, if present, the clinician should become suspicious about the benign cause of the patient's health issue and refer, if deemed necessary, the patient for further and more comprehensive medical examination (Henschke et al., 2013).

As seen in table 2.1, there exists a whole range of different “flags” to identify not only serious medical conditions but also psychosocial risk factors which are thought to help the clinician to determine if a patient needs additional (e.g. psychological) management from another healthcare professional (e.g. a psychologist) (Nicholas et al., 2011; Fawkes and Carnes, 2012).

Table 2.1: Examples of different “flags” within the literature. (Nicholas et al., 2011).

Permission obtained

Flag	Nature	Examples
Red	Signs of serious pathology	Cauda equina syndrome, fracture, tumor
Orange	Psychiatric symptoms	Clinical depression, personality disorder
Yellow	Beliefs, appraisals, and judgments	Unhelpful beliefs about pain: indication of injury as uncontrollable or likely to worsen Expectations of poor treatment outcome, delayed return to work
	Emotional responses	Distress not meeting criteria for diagnosis of mental disorder Worry, fears, anxiety
	Pain behavior (including pain coping strategies)	Avoidance of activities due to expectations of pain and possible reinjury Over-reliance on passive treatments (hot packs, cold packs, analgesics)
Blue	Perceptions about the relationship between work and health	Belief that work is too onerous and likely to cause further injury Belief that workplace supervisor and workmates are unsupportive
Black	System or contextual obstacles	Legislation restricting options for return to work Conflict with insurance staff over injury claim Overly solicitous family and health care providers Heavy work, with little opportunity to modify duties

Goodman and Snyder (2013:7-8) define red flags as:

features of the individual’s medical history and clinical examination thought to be associated with a high risk of serious disorders such as infection, inflammation, cancer, or fracture.

Such features might include, but are not restricted to, past or current severe medical conditions (e.g. cancer, tuberculosis, and infection), the regular intake of certain medications (e.g. corticosteroids) or any other substance/drug abuse (Goodman and

Snyder, 2013). In addition, physiotherapists are also advised to look for certain peculiarities within the patient's clinical presentation that do not fit with the expected pain pattern of a more trivial musculoskeletal disorder: If, for example, a patient's pain problem has suddenly started and/or without any preceding mechanical event, or if symptoms have already been resolved but return without any reason, the therapist should at least be suspicious about a true mechanical cause (Goodman and Snyder, 2013). Another typically described red flag is, when the patient's pain cannot be reproduced, altered or improved during the physical examination (Boissonnault and Bass, 1990 Part I).

[For more detailed information and discussion about different red flags for serious medical conditions of the spine, refer to chapter three, section 3.2-3.5, page 45].

The next section describes different measures of diagnostic validity for diagnostic and screening tests. This is followed by a critical discussion in section 2.4 about the usefulness of the application of measures of diagnostic validity within the clinical context of red flag screening.

2.3. Measurements of validity of diagnostic/screening tests.

When talking about measures of diagnostic validity, it is important to have an understanding of the statistical methods which assist the interpretation of the results from those testing procedures (Boissonnault, 2011). Diagnostic/screening tests need to have an acceptable level of precision to be helpful to either accurately identify or exclude a pathological process (Fritz and Wainner, 2001). Such diagnostic/screening tests are usually compared to a reference standard, which is defined as '... the patient's true status, either the presence or absence of the condition' (Portney and Watkins, 2009:620). As seen in table 2.2, a 2x2 contingency table is suggested to calculate the diagnostic test's accuracy against the reference standard (Fritz and Wainner, 2001).

Table 2.2: 2×2 contingency table for calculating the accuracy of a diagnostic test (Fritz and Wainner, 2001) permission obtained.

	Reference Standard Positive	Reference Standard Negative
Diagnostic test positive	True positive results A	False positive results B
Diagnostic test negative	False negative results C	True negative results D

As seen in table 2.3, the following statistical measures are commonly used to describe the accuracy of a diagnostic/screening test.

Table 2.3: Measures of diagnostic accuracy (Fritz and Wainner, 2001) permission obtained.

Statistic	Formula	Description
Overall accuracy	$(a + d)/(a + b + c + d)$	The proportion of test results that are correct
Positive predictive value	$1/(a + b)$	Given a positive test result, the probability that the individual has the condition
Negative predictive value	$d/(c + d)$	Given a negative test result, the probability that the individual does not have the condition
Sensitivity	$a/(a + c)$	Given that the individual has the condition, the probability that the test will be positive
Specificity	$d/(b + d)$	Given that the individual does not have the condition, the probability that the test will be negative
Positive likelihood ratio	$\text{sensitivity}/(1 - \text{specificity})$	Given a positive test result, the increase in odds favoring the condition
Negative likelihood ratio	$(1 - \text{sensitivity})/\text{specificity}$	Given a negative test result, the decrease in odds favoring the condition

2.4. Measurements of diagnostic validity in the clinical context of red flag screening.

As discussed in the previous section, diagnostic tests and screening procedures need to have an acceptable level of diagnostic accuracy to either correctly diagnose or accurately rule out the presence of a particular condition. More recently, red flags, which were originally introduced as clinical warning signs (Fawkes and Carnes, 2012), have constantly been mentioned within the context of diagnostic validity. Some authors even started to question the usefulness of red flags in general (Underwood, 2009; Underwood and Buchbinder, 2013; Cook et al., 2017). Moreover, recently published

systematic and narrative reviews reported that most red flags, especially when used in isolation, lack any diagnostic meaningfulness (Henschke et al., 2013; Downie et al. 2013; Williams et al., 2013; Finucane et al., 2017; Verhagen et al., 2017; Cook et al., 2017). Those reports make a point when they are worried, on the one hand, about the high false positive rate of most singular red flag items and, on the other hand, raise concern about their overall poor diagnostic validity (Henschke et al., 2009; Henschke et al., 2013; Downie et al., 2013; Williams et al., 2013; Verhagen et al., 2017; Cook et al., 2017). Yet, it rather appears that the current use of red flags is problematic and not the idea of red flags itself. First and foremost, red flags have not been introduced to make a final diagnosis (Fawkes and Carnes, 2012). As mentioned above, red flags are thought to be low grade clinical warning signs which, if present, should raise the level of the clinician's suspicion about the benign nature of a patient's pain problem. Secondly, no singular red flag is sufficient to either substantially raise or decrease the level of the clinician's suspicion (Goodman and Snyder, 2013). Last but not least, it is already widely recommended that clinicians should rather look at the whole clinical picture (Fawkes and Carnes, 2012; Goddman and Snyder, 2013) of a patient's individual clinical presentation instead of focusing on the presence or absence of singular red flags (Henschke et al. 2013).

This controversy about the proper application of red flags within the clinical context was highlighted by the results of five systematic reviews by Henschke et al. (2007), Henschke et al. (2013), Downie et al. (2013), Verhagen et al. (2017) and Galliker et al. (2019).

Within those reviews, the authors reported that the only individual red flag which seemed informative of having spinal malignancy and therefore justifies further medical investigation was having a past history of cancer (Henschke et al., 2007; Henschke et al., 2013; Downie et al., 2013; Verhagen et al., 2017; Galliker et al., 2019).

A previous history of cancer was reported to have a LR+ of 15.8 in primary care and LR+ of 31.7 in tertiary care (Henschke et al., 2007). Downie et al. (2013) used the same references for their own review but reported slightly different LR+ values (LR+ of 15.3 in primary care and LR+ of 35 in tertiary care). Despite minimal differences of the actual numbers between both reviews, the authors demonstrated that a previous history of cancer significantly increased the possibility of having malignancy as an underlying cause of spinal pain (Henschke et al., 2007; Downie et al., 2013), and therefore mandates

further medical investigation. However, this statement has come under attack by Underwood (2009), Underwood and Buchbinder (2013) and Finucane et al. (2017) who argued against such an undifferentiated use of this individual red flag feature (previous history of cancer) without any meaningful clinical context. Underwood (2009) Underwood and Buchbinder (2013) and Finucane et al. (2017) certainly made an important point when they said that clinicians are ill advised to automatically send every patient with a history of cancer for extensive medical check-up. If the remaining clinical presentation is in line with a benign, mechanical musculoskeletal disorder (e.g. acute mechanical low back pain with a clear onset of the complaints after an unusually long day at the office which responds well to conservative treatment), an automatic or immediate referral for additional investigation (e.g. spinal imaging) is probably not needed. On the other hand, a patient with a previous history of (e.g. prostate) cancer might describe a recent insidious onset of low back pain, which is constant and getting progressively worse, cannot be reproduced during functional screening tests and does not improve despite appropriate, conservative treatment. When considering each (except for previous history of cancer) red flag item on an individual basis (table 2.4), none are of any diagnostic importance or insignificantly raise the probability of having spinal malignancy (Henschke et al., 2007; Henschke et al., 2013; Downie et al., 2013; Verhagen et al., 2017). But when regarding the whole clinical presentation, most clinicians might at least think about the necessity of additional medical examination including advanced imaging procedures and/or blood testing to rule out sinister pathologies as underlying causes of the patient's complaints.

Table 2.4: Diagnostic properties of single red flag items for the detection/exclusion of spinal metastatic cancer.

Red flag item	Diagnostic validity	Reference
Insidious onset	LR+ 1.1, LR- 0.9	Downie et al 2013
Constant progressive pain	PPV 0% (no increase in post-test probability)	Henschke et al 2013
No Pain on movement screen	LR+ 1.3, LR- 0.8	Downie et al 2013
Not improved after 1 month (pooled estimate)	LR+ 3.0. LR- 0.79	Henschke et al 2007

2.5. Clinical Prediction/Decision Rules to screen for serious medical conditions.

Clinical prediction rules (CPRs) are useful screening tools which are thought to assist clinicians to either rule in or out the presence of more severe medical conditions, which might warrant further, more extensive investigations (Portney and Watkins, 2009). In stark contrast to the controversial use of individual red flags, Portney and Watkins (2009) describe that the major strength of clinical prediction rules is that they ‘... quantify the contributions of different variables to the diagnosis...’ and ‘... demonstrate how specific clusters of clinical findings can be used to predict outcomes’ (Watkins and Portney 2009:640).

Clinical prediction rules need to fulfil strict scientific standards before they can be finally recommended for clinical application (Childs and Cleland, 2006).

For their development and subsequent validation, CPRs have to go through three different stages (figure 2.1):

- **Derivation**
- **Validation**
- **Impact analysis**

(Childs and Cleland, 2006; Portney and Watkins, 2009; Wallace et al., 2016).

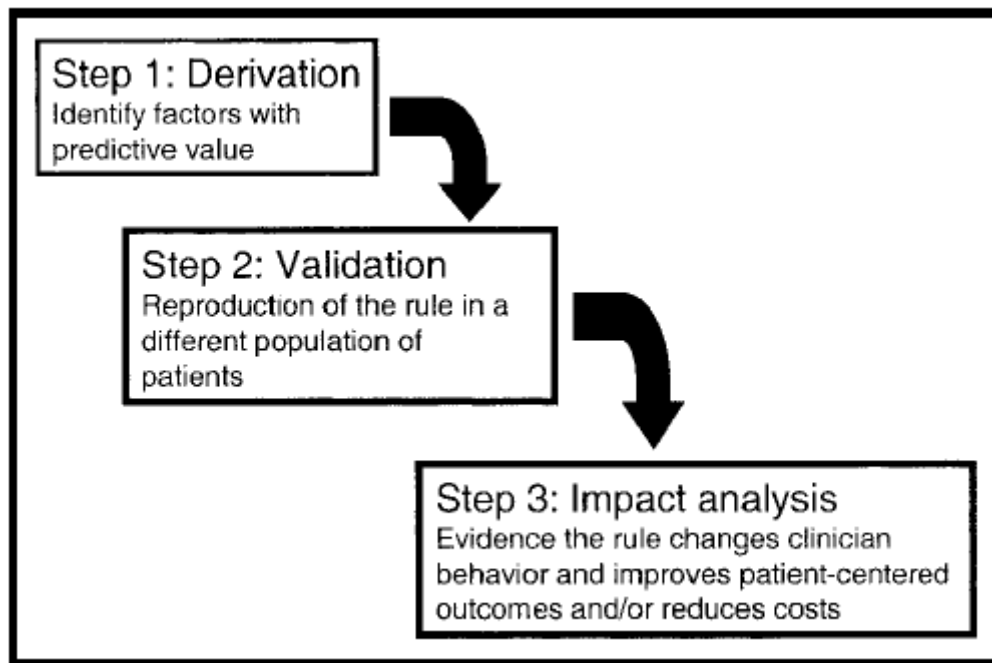


Figure 2.1: The three main developmental steps of a clinical prediction rule (Childs and Cleland, 2006). Permission obtained.

A recently published systematic review of diagnostic CPRs which have all reached impact analysis by Wallace et al. (2016) contains five musculoskeletal diagnostic CPRs, of which three are also highly relevant for physiotherapists:

- **The Ottawa ankle rules**
- **The Ottawa knee rule**
- **The Canadian c-spine rule.**

Those three clinical prediction rules have demonstrated to be highly accurate for the exclusion of acute fractures of the foot and ankle (Bachmann et al., 2003), the knee joint (Stiel et al., 1997; Emparanza and Aginaga, 2001) and the cervical spine (Stiel et al., 2009) after a trauma or an accident. In addition, they reduced the need for unnecessary imaging procedures which subsequently saves health care money. Moreover, even though not yet reached impact analysis, there is clinical decision rule available which has reached the validation phase. This clinical prediction rule assists clinicians to classify patients if they have a high, medium, low risk of suffering from a proximal deep venous thrombosis (PDVT) of the lower limbs (Wells et al., 1997).

[For more detailed information about these four clinical prediction rules, please refer to Appendix 1, page 242 of this thesis]

2.6. Summary of chapter two.

- Red Flags have been introduced to assist clinicians to either rule in or out the presence of serious pathologies.
- There is an ongoing discussion on the diagnostic performance and proper use of red flags in general.
- Clinical prediction rules are extremely powerful screening tools which have the potential (once having reached impact analysis) to either accurately rule in or out serious medical conditions.
- With the Ottawa ankles rules, the Ottawa Knee rule and the Canadian c-spine rule, there is Level 1a evidence to highly accurately rule out severe bony injuries of the ankle/foot, knee and cervical spine after a traumatic event.

Chapter Three

Screening for serious medical conditions of the spine

3.1. Introduction

In 2016, low back pain (LBP) was the leading cause of years lived with disability for men in 133 out of 195 countries and for women in 104 out of 195 countries (GBD 2016 Collaborators, 2017). With a life time prevalence of up to 70% within the general population (van Tulder et al., 2006), low back pain causes enormous health care costs in industrial countries (Henschke et al., 2013). While the majority of spinal problems are caused by benign reasons (Premkumar et al., 2018; Reito et al., 2018; Galliker et al., 2019) and is therefore classified as non-specific, there is a small proportion of patients who have a serious medical condition as an underlying cause of their back complaints (Henschke et al., 2013).

As a result of the relatively high prevalence of low back pain within the general population (van Tulder et al., 2006), some efforts have recently been made to develop screening tools that help to accurately rule in or out the presence of serious medical conditions as underlying cause of vertebral pain and, in particular, of the lower back (Henschke et al., 2009; Roman et al., 2010; Shroyer and Mehta, 2013; Germon et al., 2015; Enthoven et al., 2016; Greenhalgh et al., 2016; Premkumar et al., 2018).

It is important to keep in mind that serious pathologies affecting the vertebral column are rare (Henschke et al., 2009; Enthoven et al., 2016; de Schepper et al., 2016; Premkumar et al., 2018; Reito et al., 2018; Galliker et al., 2019). However, if missed and proper treatment is delayed, they can have disastrous effects for those being affected. Some of these conditions are even so infrequent that it is likely that most physiotherapists will never encounter them within their career (Underwood, 2009).

Clinicians and researchers also need to acknowledge that some spinal conditions might currently not be common in western countries but endemic in other parts of the world, e.g. tuberculosis (TB). However, ongoing or future migration movements might change the prevalence of some of these diseases in western societies and subsequently the way we need to assess spinal pain patients.

Chapter three addresses the first objective of this thesis:

- I. A comprehensive literature search reports the current level of evidence to detect/exclude serious pathologies of the spine.

3.2. Spinal metastatic disease.

Spinal malignancy is one of the most prevalent serious spinal pathologies (Henschke et al., 2013). Despite the fact that spinal malignancy has an overall incidence rate in primary care of no more than 1 % (Deyo and Diehl, 1988; Henschke et al., 2007; Enthoven et al., 2016), the spine is reported to be a common location of metastatic infestation (Goodman and Snyder, 2013). Early detection of those patients is of particular importance to prevent additional, devastating complications such as vertebral collapse and metastatic spinal cord compression (MSCC) which is either caused by the fracture or directly by a soft tissue tumour (Levack et al., 2002).

Most clinical guidelines advise clinicians to look for red flags which suggest the presence of malignancy as underlying cause of the patients' spinal pain (Henschke et al., 2013). However, the scientific basis and therefore clinical usefulness for most of those red flags especially when used in isolation has recently been called into question (Henschke et al., 2013). A recent review of clinical practice guidelines by Verhagen et al. (2016) revealed that there are currently 14 different red flag items included in various guidelines for the management of low back pain which, if present, should raise the possibility of spinal malignancy. The major concern about those frequently used and recommended red flags (e.g. unexplained weight loss, age > 50 years, no improvement within 4 weeks) is their high false positive rate. This means that a lot of patients who present with those clinical warning signs will be sent for further investigation such as spinal imaging procedures or blood testing, although the likelihood that they really have a serious condition is low (Henschke et al., 2013). This issue was highlighted by Henschke et al. (2009) where they evaluated a cohort of 1172 acute back pain patients in primary care settings in Australia. One striking finding was that 80% of the patients within the study cohort presented with at least one clinical red flag; yet, only 0.9% of those who were eligible for the study (n=11) actually had a serious medical condition affecting the spine with no case of spinal cancer (Henschke et al. 2009). 11 additional subjects with underlying serious medical pathologies causing their at that time current back pain

episodes (8 vertebral fractures, 2 cases of inflammatory back pain and one case with bony cancer) were excluded because the diagnosis had already been made prior to the actual start of the study (Henschke et al., 2009). The high prevalence of red flag features within the general back pain population was further substantiated in a research project which investigated the incidence rate of serious medical conditions in an MRI referral centre in the Netherlands (de Schepper et al., 2016). In contrast to Henschke et al. (2009), the majority of the study participants (n=455 out of 683) had more chronic back issues (de Schepper et al., 2016). Almost identical to the study by Henschke et al. (2009), however, was the fact that only 19% (n=127 out of 683) of all study participants had no red flag within their clinical presentation (de Schepper et al., 2016). The results by Henschke et al. (2009) and de Schepper et al. (2016) have more recently been confirmed by Premkumar et al. (2018). Over an 11 year period, almost 10,000 patients with pain in the lower back, who attended a specialist spine centre in the United States, were included in the analysis. Although the vast majority (91.7%) of the patients had no serious spinal pathology, 90% of the study sample had at least one positive red flag item within their clinical presentation (Premkumar et al., 2018).

The diagnostic dilemma which now arises from such a staggeringly high false positive rate of most red flags is that clinicians may be inclined to send the bulk of their patients for unwarranted, stressful and costly medical check-up.

Deyo et al. (2014) mention two additional problems which may result from unnecessary investigations such as spinal imaging:

- Spinal abnormalities are extremely common among the pain free population. As a consequence, most patients who are sent for spinal imaging will receive the (previously unknown) information that their spine has some sort of degeneration. Albeit mostly harmless and not clinically relevant, patients who know about those anatomical abnormalities are at risk of having poorer outcome of their rehabilitation and tend to seek more additional medical care.
- Exposure to radiation caused by spinal imaging procedures (mainly x-ray and computed tomography of the lumbar spine) is a major health concern as it itself increases the risk of getting cancer in the future.

In addition, standard plain radiography, although being highly specific (99.5%), has poor sensitivity (0.6%) when it comes to showing spinal bony metastases (Javrik and Deyo, 2002).

While Magnetic Resonance Imaging (MRI) is reported to be the most sensitive and specific imaging procedure to determine the presence/absence of spinal cancer (Javrik and Deyo, 2002), it is much more expensive than plain radiography and consequently not routinely prescribed (Joines et al., 2001).

The most widely cited study investigating the diagnostic applicability of a combination of several red flag characteristics dates back to the late 1980s (Deyo and Diehl, 1988). The components included into the final decision model were:

- Age older than 50
- A prior history of malignancy
- Unexplained weight loss
- No improvement despite conservative treatment (Deyo and Diehl, 1988).

If all of the aforementioned features were absent, cancer, as the underlying cause of the patients' complaints, could be definitively ruled out (Deyo and Diehl, 1988).

Consequently, the authors proposed a relatively easy-to-follow algorithm by subclassifying low back pain patients based on the occurrence/absence of specific red flag features into three distinct categories: low, medium and high risk of suffering from spinal cancer (Deyo and Diehl, 1988). Patients with a previous history of cancer were regarded as absolute high risk individuals, while those, as already described above, without any of the four red flag items were considered low risk patients (Deyo and Diehl, 1988). Conversely, the medium risk group consisted of patients which were older than 50 years of age, failed to improve despite conservative management, experienced weight loss without any known reason or had any other evidence of a systemic malady (Deyo and Diehl, 1988). Depending on the category, Deyo and Diehl (1988) suggested further diagnostic procedures: Subjects with a cancer disease in the medical history were advised to have immediate medical work up (blood testing and spinal radiography). Patients from the medium risk group should have blood testing alone, while those from the largest group within the study sample (low risk category) did not require any additional diagnostic evaluation as no single vertebral cancer case was

detected within this pool when all four aforementioned red flag items were absent (Deyo and Diehl, 1988).

The research by Deyo and Diehl (1988) was a large scale cohort study which prospectively evaluated almost 2000 back pain sufferers within a primary health care facility.

Having said this, the study has numerous limitations that also need to be reviewed:

First of all, there have not yet been any further attempts to validate the highly promising results by Deyo and Diehl (1988). As a consequence, there exists no recent independent data set confirming the combination of red flag features used by Deyo and Diehl (1988) to accurately rule out spinal metastatic disease as a possible cause of spinal pain (Henschke et al., 2013).

Secondly, Deyo and Diehl (1988) had an almost exclusively highly distinct study population which makes a generalization of the results particularly to a European context relatively difficult. The vast majority of the participants came from a poor socio-economic background with the largest ethnic group being Mexican-Americans (Deyo and Diehl, 1988).

The third issue concerns the choice of the diagnostic reference standard. Instead of automatically sending every back pain patient for comprehensive diagnostic check-up (blood testing and/or spinal radiography), the authors decided to apply a follow up period for at least six months from the initial consultation (Deyo and Diehl, 1988). The hospital's own tumour registry was searched for the appearance of a patient's name during the follow up period. While it is certainly correct that this period of time was sufficiently long enough for the cancer to develop, the authors admitted that there was a certain risk of losing cancer cases on follow-up. The major problem was that as most study participants could not be contacted by phone due to uncertain life circumstances, the researchers had to rely on the patients seeking care in the same health care facility (in the case of recurring or not subsiding back complaints) and not being examined and treated somewhere else (Deyo and Diehl, 1988).

And lastly, although it is beyond the capacity of this thesis to go into great detail about the diagnostic subtleties of various spinal imaging procedures, it is still remarkable that Deyo and Diehl (1988) relied on plain radiography (besides blood testing) for the diagnosis of vertebral cancer. As discussed already, plain radiography has been reported

to be of limited diagnostic value due to its low sensitivity (Javrik and Deyo, 2002).

Interestingly, Deyo and Diehl (1988) even acknowledged the diagnostic shortcomings of plain radiography and described some cases with spinal metastases whose x-rays were unsuspecting (Deyo and Diehl, 1988).

In conclusion, the preliminary results obtained by Deyo and Diehl (1988) are very promising as they provide clinicians with an easy-to-use risk assessment tool (Deyo and Diehl, 1988).

It is certainly in the interest of clinicians and patients to possess a valid tool/algorithm which assists to accurately distinguish between those who have a high risk of a severe underlying disease (in this cases spinal malignancy) and the large pool of patients with mechanic, benign back complaints.

However, in the light of the aforementioned limitations and the current lack of further validation of the initial results, the algorithm by Deyo and Diehl (1988) should be applied with caution.

More recently, de Schepper et al. (2016) assessed the prevalence of serious medical conditions among back pain patients attending a MRI referral centre in the Netherlands. Even though the authors did not specifically investigate the diagnostic properties of individual red flag items (no measurements of diagnostic validity were reported), they descriptively reported the frequency of red flag features as proposed by the Dutch clinical practice guidelines for pain in the lower back in those with a serious underlying pathology (e.g. vertebral cancer) or more benign spinal conditions (e.g. degenerative back pain) (de Schepper et al., 2016). The five red flag characteristics used for spinal malignancy were:

- Beginning of back pain after the age of 50
- Unexplained weight loss
- A prior history of cancer
- Pain at night
- Non-mechanical back complaints (de Schepper et al., 2016).

Interestingly and identical with the results by Deyo and Diehl (1988) was the fact that all cancer patients (n=5) in their sample had at least one of the aforementioned red flag items (de Schepper et al., 2016).

The major strength of the study clearly was the fact, that both reference standards (MRI investigation and long-time follow up of 12 months) made it unlikely that any serious conditions were missed.

The main limitations were, on the one hand, that it was not the primary objective of the project to create a clinical decision model or risk assessment tool in order to identify or exclude malignancy of the lumbar spine (de Schepper et al., 2016). The authors only descriptively analysed the prevalence of red flag items in isolation or combined in those with spinal cancer and in those without. The results demonstrated that red flag features were frequent within a more chronic back pain population (de Schepper et al., 2016). Hence, purely based on the presence of red flags within this study cohort, it was virtually impossible to distinguish between spinal cancer patients and the large pool of benign back pain sufferers (de Schepper et al., 2016). In addition, generalizability of the results needs to be done with caution. The setting was a highly specialized (MRI) referral centre, therefore the authors had to rely on an already preselected pool of patients which is hardly comparable to a more common primary health care setting (de Schepper et al., 2016).

Premkumar et al. (2018) analysed 9,940 low back pain patients attending a specialised spinal centre. 156 (1.6%) had a diagnosis of spinal metastatic disease. The authors reported that a combination of a previous history of cancer plus unexplained recent weight loss had a high specificity of 99.8% and a significant LR+ of 10.25. Having now a positive answer to both red flag items, the probability of actually suffering from spinal malignancy was 14.3%. It is worth noting that 64% of all spinal cancer patients within their study had no positive red flag finding as part of their clinical presentation (Premkumar et al., 2018). This high false negative rate is especially worrisome as the complete absence of red flags was traditionally thought to minimize the possibility of suffering from spinal cancer (Deyo and Diehl, 1988). The authors admitted that their suggested combination of a past history of cancer and unexplained weight loss only had a sensitivity of 2.5% and a LR- of 0.98 and was therefore not suitable for ruling out spinal malignancy (in the case of absence of these two red flags) (Premkumar et al., 2018). In conclusion, the results by Premkumar et al. (2018) highlighted the fact that the presence

of several red flag items increased the risk of suffering from spinal malignancy. However, the complete absence of a positive red flag finding did not exclude the possibility spinal metastatic disease still being present (Premkumar et al., 2018). The main strength of the study by Premkumar et al. (2018) was a very large study sample of 9,940 low back pain sufferers.

However, Premkumar et al. (2018) acknowledged that their list of red flag characteristics was by far not exhaustive. The authors only used five red flag items which had been recommended by a few published papers and one guideline (Bigos et al., 1994; Henschke et al., 2007; Henschke et al., 2008; Underwood and Buchbinder, 2013; Verhagen et al., 2016). In contrast, Verhagen et al. (2016) reported that there are 14 individual red flag items described in national and international guidelines which are supposed to be related to spinal cancer. Consequently, Premkumar et al. (2018) missed the opportunity to test a large variety of singular red flags or various combinations of several red flags.

In addition, Premkumar et al. (2018) did not specify whether their patients either had acute or more chronic back complaints. Moreover, while several patients had been referred by primary health care physicians, it was also possible to get an examination without prior medical referral (Premkumar et al., 2018). As a consequence, the results cannot exclusively be generalized to the low back pain population of a primary, secondary or tertiary health care setting.

Above all, the authors failed to describe how exactly the diagnosis of serious spinal pathology (e.g. malignancy) had been made. The authors describe that the 'diagnostic information was drawn directly from the physician entry and was corroborated by imaging reports, if the patient had received imaging' (Premkumar et al., 2018:369). The question how serious spinal pathology (if not all subjects received spinal imaging) could be ruled in or out with a high degree of confidence remains elusive. Cook et al. (2012) have already highlighted that a standard spinal screening procedure alone is insufficient to accurately distinguish between serious and benign causes of low back pain.

In the end, it remains unclear on which exact basis participants were sent for spinal imaging (Premkumar et al., 2018). The authors of the study themselves report that 64% of patients with the diagnosis of spinal malignancy did not have a red flag within their clinical presentation (Premkumar et al., (2018).

Conclusion:

With the exceptions of the level 2b studies study by Deyo and Diehl (1988) to rule out spinal malignancy in primary care and by Premkumar et al. (2018) for ruling in spinal cancer in a mixed health care context, there is currently a lack of high level evidence to accurately rule in/out the presence of spinal metastatic disease.

3.3. Spinal fracture.

Spinal fractures have, with a prevalence in primary care ranging between 1% (Henschke et al., 2009) and 5% (Enthoven et al., 2016) and in tertiary care possibly up to 11% (Henschke et al., 2013), the highest incidence rate amongst all serious conditions affecting the vertebra and have therefore the highest likelihood of being encountered by clinicians who examine and/or treat spinal patients.

There have been some attempts to combine clinical red flags for the identification/exclusion of a possible fracture of the spine (Henschke et al., 2009; Roman et al., 2010; Enthoven et al., 2016). These studies will be discussed below:

In a prospective cohort study on 1172 patients seen in primary care, Henschke et al. (2009) identified 3 clinical features (age > 70 years, significant trauma, prolonged use of corticosteroids) which were all highly specific (specificity ranging from 96%-100%) for identifying a spinal fracture (table 3.1).

Table 3.1: Diagnostic accuracy of individual red flags for the identification/exclusion of fractures of the spine (Henschke et al., 2009). Permission obtained.

Red flag question	No. (%) red flag positive	Sensitivity, %	Specificity, %	Positive LR (95% CI)	Negative LR (95% CI)
Age >70 years	56 (4.8)	50	96	11.19 (4.65–19.48)	0.52 (0.23–0.82)
Significant trauma (major in young, minor in elderly)	31 (2.6)	25	98	10.03 (2.76–26.36)	0.77 (0.42–0.95)
Prolonged use of corticosteroids	8 (0.7)	25	100	48.50 (11.62–165.22)	0.75 (0.41–0.93)
Sensory level (altered sensation from trunk down)	19 (1.6)	0	98	0.00 (0.00–21.01)	1.02 (1.02–1.03)
Clinician diagnosis of fracture	7 (0.6)	50	100	194.00 (52.10–653.61)	0.50 (0.22–0.79)

As seen in table 3.2, combining those 3 clinical features together with sex (female), Henschke et al. (2009) established a diagnostic clinical prediction rule.

Table 3.2: Diagnostic validity with several cut off points to rule in/out spinal fractures (Henschke et al., 2009). Permission obtained.

	Criteria for a positive test		
	1 positive feature	≥2 positive features	≥3 positive features
Sensitivity, %	88	63	38
Specificity, %	50	96	100
Positive LR (95% CI)	1.8 (1.1–2.0)	15.5 (7.2–24.6)	218.3 (45.6–953.8)
Posttest probability of vertebral fracture, %			
Pretest probability 0.5%	1	7	52
Pretest probability 3%	5	32	87

* Four features were included in the rule: female sex, age >70 years, significant trauma (major in young patients, minor in elderly patients), and prolonged use of corticosteroids. LR = likelihood ratio; 95% CI = 95% confidence interval.

As seen in table 3.2, having 2 (LR+ 15.5) or 3 (LR+ 218.3) out of those 4 clinical red flags significantly raised the possibility of having a fracture of the spine, and, with a rather realistic prevalence of 3% in primary care, having 2 positive features increases the post-test probability to 32% and having 3 items even up to 87% (Henschke et al., 2009).

Henschke et al. (2009) pointed out that their results were fairly consistent with a (at that time) recent systematic review by Henschke et al. (2008) about individual red flags to identify vertebral fractures. The only exception is the long term intake of corticosteroids which has been described in the systematic review by Henschke et al. (2008) to be of little diagnostic importance.

While the initial results by Henschke et al. (2009) seemed certainly promising and worth further consideration for future clinical use, Enthoven et al. (2016) failed to reproduce the findings by Henschke et al. (2009). Enthoven et al. (2016) still found a moderate association of having 2 out of 4 clinical features of the diagnostic clinical prediction rule by Henschke et al. (2009) when applied to their own cohort. Their calculated positive likelihood ratio of 2.6 was, on the other hand, noticeably lower than the positive likelihood ratio of 15.5 in the Henschke et al study in 2009 (Enthoven et al., 2016).

Unfortunately, Enthoven et al. (2016) failed to report the likelihood ratios for patients who had 3 out of 4 clinical features. Neither did they say if there were any patients who had more than 2 red flag items from the diagnostic tool by Henschke et al. (2009)

(Enthoven et al., 2016). Instead, Enthoven et al. (2016) used their own diagnostic clinical prediction rule combining 5 clinical red flags (osteoporosis, age > 75, trauma, back pain intensity score >7, thoracic pain) (table 3.3).

Table 3.3: Diagnostic accuracy of clinical prediction rule (Enthoven et al., 2016).

Permission obtained

Red Flag	Sensitivity	Specificity	PV+	PV-	LR+	LR-
Diagnostic prediction model ^d						
≥1 positive features (n=397)	0.88 (0.77, 0.99)	0.42 (0.38, 0.46)	0.07 (0.05, 0.10)	0.99 (0.97, 1.00)	1.5 (1.3, 1.8)	0.3 (0.1, 0.7)
≥2 positive features (n=145)	0.70 (0.54, 0.85)	0.81 (0.78, 0.84)	0.16 (0.10, 0.22)	0.98 (0.97, 0.99)	3.6 (2.8, 4.8)	0.4 (0.2, 0.6)
≥3 positive features (n=43)	0.30 (0.15, 0.46)	0.95 (0.93, 0.97)	0.23 (0.11, 0.36)	0.96 (0.95, 0.98)	5.8 (3.2, 10.8)	0.7 (0.6, 0.9)

Despite the fact that their results still yielded some clinically important results, the likelihood ratios within their cohort were generally lower than from Henschke et al. (2009).

Enthoven et al. (2016) explained the deviant results from those obtained by Henschke et al. (2009) with their very distinct study population of advanced age. Enthoven et al. (2016) had 109 participants who were older than 75 years of age. Henschke et al. (2009), on the other hand, only had 56 patients who were older than 75. This might also be an explanation for the actual numbers of vertebral fractures: Although Henschke et al. (2009) examined almost twice as many patients, they only found 8 vertebral fracture cases. In contrast, Enthoven et al. (2016) found 33 cases of osteoporotic fractures within their study sample. Older age is highly correlated with osteoporosis (in both men and women) and subsequently sustaining a compression fracture of the spine (Kim and Vaccaro, 2006). However, apart from the fact that the participants in the study by Enthoven et al. (2016) were, on the average, 20 years older, Henschke et al. (2009) only examined low back pain patients. Enthoven et al. (2016), on the other hand, also included patients whose main complaint was in the thoracic region of the vertebral column. Unfortunately, Enthoven et al. (2016) did not report the frequencies of fractures in the thoracic spine as compared to the lumbar region. It is quite possible that not only the difference in age but also the region of vertebral pain might have an impact on the results. Consequently, a direct comparison of the results by Enthoven et al.

(2016) and Henschke et al. (2009) should only be made by acknowledging the substantial differences between the two studies.

Roman et al. (2010) retrospectively analysed 1448 patients who attended a tertiary care spinal surgery centre between 2005 and 2009. 38 patients (2.6 %) with a spinal osteoporotic fracture were identified. The authors combined 5 clinical red flags (age > 52 years, body mass index < 22, female gender, no presence of leg pain, does not exercise regularly) to form a diagnostic decision rule. As presented in table 3.4, having only 2 out of 5 features yielded a negative likelihood ratio of 0.16 and therefore seemed informative to rule out the presence of a spinal fracture. On the other hand, having 4 out of 5 items resulted in a positive likelihood ratio of 9.6 which increased (based on a pre-test probability of 2.6% within the study cohort) the post-test probability up to 20% of suffering from an osteoporotic vertebral fracture.

Table 3.4: Diagnostic accuracy of clinical prediction rule to rule in/out vertebral fractures in tertiary care (Roman et al., 2010). Permission obtained.

Clustered results	Sensitivity (95% CI)	Specificity (95% CI)	Positive likelihood ratio (95% CI)	Negative likelihood ratio (95% CI)	Post-test probability of CTS (%)
1 of 5 positive tests	0.97 (0.89–0.99)	0.06 (0.06–0.07)	1.04 (0.92–1.1)	0.39 (0.07–2.1)	2.7
2 of 5 positive tests	0.95 (0.83–0.99)	0.34 (0.33–0.34)	1.4 (1.3–1.8)	0.16 (0.04–0.51)	3.6
3 of 5 positive tests	0.76 (0.61–0.87)	0.68 (0.68–0.69)	2.5 (1.9–2.8)	0.34 (0.19–0.46)	6.3
4 of 5 positive tests	0.37 (0.24–0.51)	0.96 (0.95–0.97)	9.6 (3.7–14.9)	0.65 (0.50–0.79)	20.4
5 of 5 positive tests	0.03 (0.01–0.08)	0.99 (0.98–0.99)	9.3 (1.4–60.2)	0.97 (0.92–0.99)	19.9

Note: Five findings are included in the rule: (1) age > 52 years; (2) no presence of leg pain; (3) body mass index ≤ 22; (4) does not exercise regularly; and (5) female gender. The associated post-test probability values are based on a pre-test probability of 2.6%.

While single red flags were, again, of generally poor diagnostic value, combinations of clinical warning signs demonstrated some promising results and seemed helpful to either rule in or exclude spinal fractures in tertiary care (Roman et al., 2010).

Conclusion:

There is consistent Level 2b evidence to rule in the presence of osteoporotic fractures in primary and tertiary care. However, further validation is needed before the aforementioned decision models can be widely recommended for clinical application.

3.4. Spinal infection.

Even though spinal infection is rare and Underwood (2009) regards this condition as a '... once-in-a-lifetime diagnosis for most practitioners working in primary care' (Underwood, 2009:2856), bacterial infection, primarily of the intervertebral disk (spondylodiscitis), should still be considered as a possible cause of spinal pain (Cottle and Riordan, 2008; Goodman and Fuller, 2009). Probably because of its low prevalence in Western/developed countries, Henschke et al. (2009) and Enthoven et al. (2016) did not encounter any case of spinal infection in their large scale prospective cohort studies of back pain patients in primary care.

Kapsalaki et al. (2009) could identify eight patients with spondylodiscitis in their prospective cohort study at the Department of Medicine of the Medical School at the University of Thessaly/Greece during 2005-2007. Unfortunately, the authors failed to report how many patients were examined during their two year study period. As a consequence, it is impossible to determine the incidence rate of spinal infection within their study cohort. Interestingly however, almost all (six out of eight) patients suffered from diabetes mellitus and five out of eight patients had fever $>38^{\circ}\text{C}$. Despite the fact that fever $>38^{\circ}\text{C}$ was quite prevalent in those diagnosed with spondylodiscitis (Kapsalaki et al., 2009) and fever $>38^{\circ}\text{C}$ is also frequently endorsed by national guidelines for the identification of spinal infection (Verhagen et al., 2016), Henschke et al. (2009) did not include this particular red flag into their list of screening items for identifying spondylodiscitis within their own cohort (Henschke et al., 2009).

In a large scale prospective cohort study, Shroyer and Mehta (2013) evaluated over a six year period almost 10,000 spinal (back and neck) pain patients who sought medical care in an emergency department in the United States. Those patients who had fever $>38^{\circ}\text{C}$ or a recent history of fever, any of ten risk factors (as seen in table 3.5), worsening neurological deficits, excruciating back pain or if the examiner suspected an infection as underlying cause of the back complaints, received further examination including laboratory testing (C-reactive protein) and medical imaging (MRI) (Shroyer and Mehta, 2013).

Table 3.5: Ten risk factors which increase the possibility of suffering from a spinal infection (Shroyer and Mehta 2013). Permission obtained

Risk Factors (block variable)
Diabetes
IVDU*
Recent MRSA skin abscess or bacteremia within past two months
Recent spine procedure within two months
Dialysis patient
Indwelling IV catheter (e.g. mediport)
Immunocompromised patient (e.g. cancer, organ transplant patient)
Cirrhotic liver disease patient
Intraspinal device present (e.g. spinal cord stimulator, morphine or baclofen pump, lumbar-peritoneal shunt etc.)
Vertebral fracture within two months

44 cases (0.44%) of spinal infection could be detected. Using the data from those 44 cases, the authors created a screening tool called *Spine Infection Risk Calculation Heuristic (SIRCH)* (table 3.6). As seen in table 3.6, Shroyer and Mehta (2013) combined certain risk factors from the literature with the most common clinical findings from those 44 patients with a confirmed diagnosis of spinal infection. The authors concluded that if a patients has a SIRCH score equal or more than three, there is a high probability that this patient is suffering from an infection of the spine (a SIRCH score greater than three was present in 97.6% of those 44 cases with a confirmed diagnosis of spinal infection) (Shroyer and Mehta, 2013).

Table 3.6: Calculation of SIRCH score to identify/exclude spinal infections (Shroyer and Mehta, 2013). Permission obtained.

Categorical Variables (0 value if absent)	Value
Risk factors (the presence of any of 10).....	1
Fever $\geq 101^{\circ}$ F or recent history of fever.....	2
Progressive neurologic deficit	1
CRP ≥ 50 mg/L.....	2
SIRCH Score.....	(sum)

Unfortunately, this study was solely presented as a supplement in the Research Forum Abstracts in 2013 in the Annals of Internal Medicine. As a consequence, it was not possible to access the whole article (if one exists).

In a study sample of 9,940 low back pain patients presenting at a specialized spinal clinic between July 2005 and February 2016, Premkumar et al. (2018) found 120 (1.2%) cases of spinal infection. In contrast to Shroyer and Mehta (2013), patients whose chief complaint was pain in the cervical region were excluded from the study (Premkumar et al., 2018). In the case of a back pain patient who also has fever, chills, persistent sweating at night and an additional history of a recent infection, the likelihood of suffering from spinal infectious disease was 13.8% (specificity: 99.4%; LR+: 13.15%) (Premkumar et al., 2018). While the numbers for the specificity and LR+ were statistically significant, the resulting post-test probability of 13.8% of actually suffering from spinal infection needs to be critically viewed. If the presence of red flags results in a 14% chance of actually having spinal infection, one might ask the question if further extensive medical investigation is really automatically justified. Apart from that, the absence of fever, chills and sweating did not decrease the possibility of still having a spinal infection (Premkumar et al., 2018).

Conclusion:

There is currently no high level evidence or validated clinical decision rule to rule in/out spinal infection.

3.4.1. Tuberculous spondylodiscitis/Spinal tuberculosis.

While neither Shroyer and Mehta (2013) nor Premkumar et al. (2018) did not specify the potentially different causes of spinal infection, there exists one condition in particular which is described within the literature on a more regular basis and should therefore not be left unmentioned:

Tuberculosis (TB) is generally described as ‘... a disease of poverty ...’ (Garg and Somvanshi 2011: 440). Although TB is particularly prevalent in underdeveloped parts of Africa and South East Asia (Garg and Somvanshi, 2011), continuous immigration from those regions to Western societies makes TB a worldwide health problem (Garg and Somvanshi, 2011; Trecarichi et al. 2012). Even though the vertebral column is the most commonly affected site of extra pulmonary manifestation (also called Pott’s disease) (Garg and Somvanshi, 2011; Trecarichi et al., 2012), skeletal tuberculosis, in general, is infrequent (Goodman and Snyder, 2013).

Recent large scale prospective cohort studies on back pain patients in primary care did not report any cases of spinal tuberculosis (Henschke et al., 2009; Enthoven et al., 2016). Apart from the fact that those studies were conducted in regions where TB is certainly not common (Australia and the Netherlands respectively), there are other reasons which made a detection of spinal TB within their study cohorts even less unlikely: First of all, Henschke et al. (2009) only examined low back pain patients. Spinal tuberculosis, however, is more prevalent in the thoracic spine (Trecarichi et al., 2012). Secondly, although Enthoven et al. (2016) also included patients with pain in the thoracic region, their study population was too old (>55 years of age) as to find many cases of spinal TB. Tuberculous spondylodiscitis is mainly found in patients between the age of 30-40 (Trecarichi et al., 2012). Shroyer and Mehta (2013) and Premkumar et al. (2018) found a few cases of spinal infection within their large scale prospective research studies conducted in tertiary health care settings in the United States. While the authors did not further specify on the different causes of spinal infection within their cohorts, it is rather unlikely that they even considered tuberculosis as a major risk of getting an infection of the vertebra. As seen in table 3.5, having suffered or being currently infected by tuberculosis was not included into the risk factors for spinal infection by Shroyer and Mehta (2013).

While it is probably less likely that many physiotherapists (especially those working in well-developed regions) will see a lot of spinal TB cases within their career (Goodman and Fuller, 2013), Garg and Somvanshi (2011) and Trecarichi et al. (2012) point out that a certain amount of suspicion should remain particularly when treating patients who are either infected with the human immunodeficiency virus (HIV), who have a history of tuberculosis, in those with a low socioeconomic status or who immigrated from regions where tuberculosis is a widespread health problem (Garg and Somvanshi, 2011; Trecarichi et al., 2012).

Conclusion:

Apart from certain risk factors which might indicate the presence of spinal TB, there are, at the moment, no scientifically validated guidelines to detect spinal TB as the underlying cause of back complaints.

3.5. Cauda Equina Syndrome.

Cauda equina syndrome (CES) describes a condition where neural structures within the lumbar spinal canal are seriously compromised. CES is regarded as an absolute medical emergency situation (Gitelman et al. 2008) where early surgical attention is crucial (Greenhalgh et al., 2015). A delay of appropriate (surgical) treatment may have devastating consequences for a patient's health (Germon et al., 2015), possibly leading to incontinence, sexual dysfunction (Lavy et al., 2009) or even paraplegia (Cook et al., 1998).

Although all clinicians need to be aware that spinal patients might have a CES as the reason why they seek medical care (Underwood, 2009), it must be acknowledged its low overall incidence rate makes it such a rare condition (Greenhalgh et al., 2018) that most primary care clinicians will never encounter a CES in their clinic/practice (Lavy et al., 2009). In a study conducted in Slovenia, Podnar et al. (2007) calculated that 0.12% of all herniated discs will subsequently lead to CES. Gitelman et al. (2008), on the other hand, state that CES happens in 2% of disc herniations. While the exact numbers remain unclear and the overall prevalence is certainly low (Henschke et al., 2009; Enthoven et al., 2016; de Schepper et al., 2016; Premkumar et al., 2018; Galliker et al., 2019) CES is, nonetheless, regarded as a surgical emergency which requires appropriate (immediate) surgical attention (Gitelman et al., 2008). As a consequence, a delay in the diagnosis may, in contrast to more chronic conditions such as spinal inflammatory disease, have disastrous consequences for the patient (Underwood, 2009). It is therefore imperative that all clinicians working with spinal patients have a detailed knowledge about the clinical presentation of CES (Fraser et al., 2009). A comprehensive literature review by Fraser et al. (2009) aimed at finding the most informative clinical warning signs that should alert the clinician about the possibility of a CES. While no individual red flag within the articles being reviewed reached 100% consensus, the most frequently described features for the identification of CES were bladder dysfunctions and abnormal sensation (Fraser et al., 2009). Despite ongoing discussions about the definition of bladder dysfunctions (retention or incontinence) and the exact location of abnormal sensations, the authors of the review suggest following clinical decision model to identify CES: In a spinal pain patient with either bladder/bowel dysfunction, saddle

paraesthesia or sexual dysfunction possibly combined with neurological impairments of the lower limbs, CES should be suspected and further medical evaluation has to be carried out (Fraser et al., 2009).

Whilst such a (differential) diagnostic approach as proposed by Fraser et al. (2009) seems logical, Bell et al. (2007) raised concern about the relatively high false positive rate of clinical warning signs (e.g. bladder dysfunctions or lack of perineal sensation) which are thought to identify CES as the cause of the patients complaints. In their study, even experienced neurosurgeons in a tertiary neurosurgical centre made a wrong diagnosis in 43% of all cases with suspected CES (Bell et al., 2007). These results are consistent with those obtained by Ahad et al. (2015) who concluded that commonly described clinical features which are thought to be associated with CES (e.g. bowel/bladder incontinence, urinary retention, diminished rectal tone and saddle paraesthesia) are not predictive of finding an actual CES case during subsequent MRI examination (Ahad et al., 2015). Domen et al. (2009), on the other hand, found in a retrospective analysis of 58 suspected CES sufferers a non negligible correlation of ultrasound measured urinary retention (>500 millilitres) and a compression of the cauda equina as verified by MRI investigation. The authors concluded that there should be a high amount of suspicion in back pain patients who have a measured urinary retention of more than 500 millilitres alone or together with at least two of the following features: sciatica into both legs, subjective feeling of urinary retention or rectal incontinence (Domen et al., 2009). Interestingly, neither Bell et al. (2007) nor Domen et al. (2009) found the very popular clinical sign saddle paraesthesia to be predictive of diagnosing CES during magnetic resonance imaging procedure. Balasubramanian et al. (2010), on the other hand, found a loss of sensation in the region between the inner parts of the thighs, buttocks and perineum (=saddle paraesthesia) to be highly indicative of a MRI verified compression of the cauda equina. Having said this, Balasubramanian et al. (2010) admitted that no individual clinical sign seemed to be absolutely diagnostic for CES. The overall questionable diagnostic accuracy of most individual red flags for the cauda equine syndrome has more recently been confirmed and summarised in a systematic review by Dionne et al. (2019).

And yet, clinicians need to be vigilant not to miss any signs and symptoms of a possible compression of the cauda equina (Balasubramanian et al., 2010; Greenhalgh et al., 2018).

The British Association of Spine Surgeons (BASS) acknowledges that many patients with signs and symptoms of a suspected compression of the cauda equina will eventually not have CES (Germon et al. 2015). Yet, Germon et al. (2015:35) state that:

a patient presenting with acute (de novo or as an exacerbation of pre-existing symptoms) back pain and/or leg pain with a suggestion of a disturbance of their bladder or bowel function and/or saddle sensory disturbance should be suspected of having a CES.

Moreover, '... in the absence of reliably predictive symptoms and signs, there should be a low threshold for investigation with an emergency [MRI] scan' (Germon et al., 2015:35).

In a systematic review, Todd (2017) also criticises that numerous red flags as suggested in several guidelines should rather be termed white flags (=flags of surrender) as they describe signs and symptoms (e.g. urinary and faecal incontinence, perineal anaesthesia) of a clinical picture of non-treatable, irreversible CES. The author proposes that clinicians should focus on the detection of symptoms (e.g. bilateral radiculopathy, worsening neurological deficits in the lower limbs, defective anal tone) of early and still treatable CES (Todd, 2017). Todd (2017) acknowledges that lowering the referral threshold will inevitably lead to an increase in MRI referrals.

Apart from ongoing diagnostic uncertainties within the current literature (Dionne et al., 2019), Greenhalgh et al. (2015) raise one additional issue which needs to be taken into consideration: In order to be able to either include or exclude CES as potential cause of the patient's complaints, clinicians are required to address rather sensitive topics during the patient's interview (e.g. sexual functions or urinary/faecal incontinence). Greenhalgh et al. (2015) warn clinicians not to use medical jargon (e.g. bowel/bladder dysfunctions). Instead, the authors urge clinicians to adopt descriptions which patients are able to comprehend (Greenhalgh et al., 2015). The problem with medical jargon is that even if a patient may actually have a diminished feeling in the area between the anus and scrotum/vagina, they might negate this fact simply because they do not know what is

meant when being asked by the clinician about any sensational changes in the perineal region.

Conclusion:

There is currently a lack of high level evidence to accurately detect CES solely based on clinical signs and symptoms.

3.6. Critical discussion about the importance of screening for serious medical pathologies and problems with how it is performed and recommended in current guidelines.

There is an ongoing critical discussion about the current approach on how to screen patients for the presence of serious medical conditions which mimic rather benign syndromes of the musculoskeletal system (Cook et al., 2017). In addition, recently published systematic (Downie et al., 2013; Williams et al., 2013; Henschke et al., 2013; Verhagen et al., 2016; Galliker et al., 2019) and narrative reviews (Cook et al., 2017) cast doubt on the differential diagnostic value of most red flag items especially when used in isolation. Especially worrisome for critics is the fact that the high false positive rate of most red flags leads to an increase in unnecessary imaging and/or unwarranted medical procedures (e.g. surgery) which themselves might be harmful for patients (Buchbinder and Underwood, 2013; Cook et al., 2017). When looking at the title of an editorial by Underwood & Buchbinder (2013) called 'Red flags for back pain: A popular idea that didn't work and should be removed from guidelines' (Underwood and Buchbinder, 2013:1), one might initially think that the authors even suggest that screening for serious medical conditions should be completely abandoned. However, the authors of this paper still acknowledge the need to accurately detect serious underlying conditions but instead express concern about the current approach within the literature (Underwood and Buchbinder, 2013) and as suggested in several national and international guidelines (Verhagen et al., 2016).

At this stage, one might get the impression that there only exist serious medical conditions that can cause spinal pain. While it is true that spinal pain, due to its high prevalence, deserves a lot of attention, there are also other body regions which also

should not be neglected. As outlined in chapter two, section 2.5, page 41 and in Appendix one, page 242 of this thesis, there already exist some highly precise screening resources which help to accurately detect or rule out serious conditions (fractures of the foot, knee, ankle and cervical spine after a traumatic event, proximal deep venous thrombosis of the lower limbs) which require early detection and subsequent professional, medical care (Wells et al., 1997; Emparanza and Aginaga, 2001; Bachmann et al., 2003; Stiel et al., 2007; Stiel et al., 2009).

Coming back to medical screening of the vertebra, there is overall consensus that the poor diagnostic performance of most individual red flag items for the detection/exclusion of serious spinal conditions is indeed worrying (Cook et al., 2017; Premkumar et al., 2018). Even more problematic is the seemingly uncritical use of those clinical warning signs in many national and international low back pain guidelines (Verhagen et al., 2016). The main problem arising from current screening approaches primarily for serious pathologies affecting the vertebra probably is the undifferentiated application of single red flags without any meaningful clinical context (Underwood and Buchbinder, 2013).

Boissonnault and Ross (2012) published a review of case reports and case series where comprehensive clinical reasoning and decision making skills applied by physiotherapists proved to be highly effective in helping to detect a wide range of different serious conditions. The point here is that those physiotherapists certainly did not rely on single, individual red flags but rather regarded the whole clinical picture and several combined clinical findings.

3.7. Possible implications for future screening alternatives.

When looking at the existing evidence of the (differential) diagnostic capabilities of commonly used and described red flags for serious spinal disorders, it is certainly true that most of those clinical red flag features especially in isolation cannot be recommended for an uncritical clinical use. As described in chapter three of this thesis (section 3.2-3.5., page 45) there have been some attempts to combine various clinical findings and/or develop clinical prediction rules with various cut off points which should assist clinicians to detect sinister pathologies affecting the spine or masquerading more benign spinal pain disorders (Deyo and Diehl, 1988; Henschke et al., 2009; Roman et al.,

2010; Shroyer and Mehta, 2013; Enthoven et al., 2016; Premkumar et al., 2018).

However, most of these results need further validation before they can be recommended for actual clinical application. On the other hand, the Ottawa ankle rules (Bachmann et al., 2003), the Ottawa knee rule (Emparanza and Aginaga, 2001), the Canadian c-spine rule (Stiel et al., 2009) and to some extent the Wells score (Wells et al., 1997) have been shown to be useful resources to accurately rule out serious injuries/conditions which should not remain undetected. It would be unwise not to use such excellent tools as part of the clinical decision making process.

Interestingly, Henschke et al. (2007) mention the term ‘... overall clinical judgement ...’ (Henschke et al., 2007:1673) which had a pooled positive likelihood ratio of 12.1 when looking for spinal malignancy. Similar to overall clinical judgement, Verhagen et al. (2017) describe ‘... strong clinical suspicion ...’ (Verhagen et al., 2017:1860) which had a positive likelihood of 12.0-54.2 for identifying vertebral cancer. Unfortunately, neither Verhagen et al. (2017) nor Henschke et al. (2007) elaborated what exactly overall clinical judgement/strong clinical suspicion exactly entails. It is believed that overall clinical judgement/strong clinical suspicion might describe the gut feeling that something about the patient’s clinical presentation does not fit. It is the clinician’s subjective sense that there might be something wrong with this patient and therefore additional medical examination is warranted. As pointed out by Boissonnault (1995), clinical decisions are always made based on a combination of the patient’s interview and physical examination. The majority of studies so far, however, have either predominantly looked at red flags obtained during a patient’s interview (Henschke et al., 2009; Enthoven et al., 2016; Premkumar et al., 2018) or exclusively as part of the subsequent physical examination (Cook et al., 2012).

Boissonnault and Ross (2012) have already demonstrated that through a skilled and comprehensive clinical decision making process that combines several aspects from the patient’s interview, various risk factors and the physical assessment, physiotherapists are capable of detecting a wide range of pathologies that are not amenable by physiotherapy.

Future research which aims at ruling in/out serious medical conditions affecting the musculoskeletal system should stop focusing on individual red flag items which are either obtained during the interview process or physical investigation.

Instead, it might be a better idea to combine clinical findings of the patient's interview and the physical examination. It would be interesting if large scale prospective cohort studies would be able to validate the positive results which have been achieved in diverse case studies (Boissonnault and Ross, 2012) of which the medical literature is full of.

An ongoing research project by the International Federation of Orthopaedic Manipulative Physical Therapists (IFOMPT) aims at creating an evidence based consensus framework on which red flags are informative for spinal metastatic disease, spinal fracture, spinal infection and the cauda equine syndrome (Finucane and Mercer, 2019).

The consensus framework for the identification of spinal metastatic disease, spinal fracture, spinal infection and the cauda equine syndrome (Finucane and Mercer, 2019) is very similar to the existing one by Rushton et al. (2014) for the detection of cervical arterial dysfunction (CAD) prior to cervical manual/manipulative interventions.

The development of an evidence based consensus framework for the identification of serious spinal pathologies (spinal metastatic disease, spinal fracture, spinal infection and the cauda equine syndrome) is urgently needed. In the context of undergraduate and postgraduate physiotherapy education, such a framework will help in addressing current uncertainties about which (clusters of) red flags are really informative and therefore need to be mandatorily taught during undergraduate and postgraduate education. In addition, such framework can be used as evidence based guidance for physiotherapy students and qualified physiotherapists as to when a medical referral, based on the presence of certain red flags, is indicated.

A different approach for detecting the presence of medical circumstances that negatively impact a patient's health status has been proposed by George et al. (2015). George et al. (2015) completely dismissed the idea of red flags screening '... done for the sole intent of identifying underlying pathology' (George et al., 2015:513). Instead, their aim was the creation of a standardised screening tool to assist clinicians with the identification of signs and symptoms potentially indicating a pathological involvement of one of the major body system (urogenital, pulmonary, cardiovascular, gastrointestinal, endocrine, nervous, integumentary and musculoskeletal) (George et al., 2015). The rationale for this was the assumption that concomitant pathological processes, if

remained undetected, would possibly have adverse effects on numerous outcome measures (e.g. pain, functional scores, quality of life, disability, disease burden) (George et al., 2015). Consequently, such multi morbid patients would be ‘... at risk for poor [treatment] outcomes ...’ (George et al., 2018:471). Through a comprehensive literature search, the authors at first created a standard 23-item screening tool for the purpose of providing clinicians with ‘... an initial indication of whether more thorough review (including the option of additional diagnostic testing) is a necessary part of patient care ...’ (George et al., 2015:513). A positive feedback to one or several of the screening questions might also trigger a referral to another health care professional (e.g. a physician) (George et al., 2015). The second step involved testing the 23-item screening tool on a sample of 431 patients with mainly either vertebral (lumbar or cervical), knee or shoulder pain complaints (George et al., 2015). This was done to determine if the newly developed screening instrument was able to accurately identify patients who had at least one red flag feature (George et al., 2015). At the same time, the 23-item screening instrument was tested against the Charlson Comorbidity Index (Charlson et al., 1987) and the Functional Comorbidity Index (Groll et al., 2005). These two indices comprised a list of 18 (Charlson Comorbidity Index) and 19 (Functional Comorbidity Index) medical conditions (e.g. myocardial infarct, peripheral vascular disease, ulcer disease). Patients were asked to indicate whether they had ever received a diagnosis with one of those pathologies (George et al., 2015). The reason for this was to assess a potential overlap of positive red flag responses and existing and already known medical diagnoses (George et al., 2015). The outcome demonstrated that the 23-item tool, firstly, managed to identify all red flag responders in the study sample. Secondly, there was no significant overlap between positive red flag responses and already known medical conditions as a priori identified by the Charlson Comorbidity and Functional Comorbidity indices. Hence, this newly developed screening tool was a useful supplementary instrument to already existing comorbidity questionnaires (Charlson Comorbidity Index and Functional Comorbidity Index). The results provided preliminary evidence that the newly developed tool managed to accurately identify patients with signs and symptoms which may be indicative of additional existing conditions affecting the major body systems (George et al., 2015). A third step of the instrument development involved the validation of the 23-item tool during a longitudinal cohort

study. The main outcome of interest was to determine any association of positive responses to the 23-item screening tool with changes in the comorbidity status at 12 month follow-up (George et al., 2018).

George et al. (2018:471) chose the Comorbidity status as the primary outcome measure for the following reason:

... musculoskeletal pain burden may be exacerbated by the presence of multiple comorbid conditions, which can independently influence the trajectories of perceived health status, functional impairment, and disability.

The results showed that additional pathological abnormalities of the main body systems (assessed by a positive response to the 23 item screening tool) influenced the comorbidity status at 12 month follow-up (George et al., 2018). This finding by George et al. (2018) was important and unique at the same time. Important, since especially older patients tend to suffer from multiple chronic conditions (= multi morbidity) (Goodman and Synder, 2013). It is therefore crucial to detect potential barriers for recovery and therapy progress (George et al., 2018). Unique, as the screening process by George et al. (2015) was the introduction of an innovative direction of red flag screening. Instead of using red flags as mere warning sign for specific serious pathologies, George et al. (2015) introduced the idea of detecting problems within body systems (urogenital, pulmonary, cardiovascular, gastrointestinal, endocrine, nervous, integumentary and musculoskeletal). If remain undetected and left untreated, they may have negative consequences for therapeutic interventions and patients' symptom progression and therefore justify a referral to the appropriate health professional (George et al., 2018). It is valuable to have a tool that predicts therapy indication and therapeutic success. Yet, it is still important to additionally assess a patient for the presence of serious medical conditions which require immediate medical attention. The newly developed screening instrument by George et al. (2015) may serve as an initial standard check list and, if positive, would prompt further more in-depth questioning about a specific organ system (George et al., 2015). Although current red flag screening approaches especially for spinal conditions are prone to error, the general idea of detecting the presence of serious medical pathologies within a patient's clinical presentation should not be completely abandoned from the clinical decision making process. Instead, it is important to regard the patient's whole clinical picture and make

decisions based on the results of a thorough clinical examination for each patient on an individual basis (Reito et al., 2018).

3.8. Summary of chapter 3

- There have been several attempts to accurately rule in or out the presence of serious conditions affecting the vertebral column.
- There is insufficient evidence to recommend the wide clinical application of current clinical decision rules for the detection/exclusion of serious spinal conditions.
- Future research should stop looking at single red flag items.
- Instead, a combination of several clinical findings obtained during the patient's interview and physical examination might be a more sensible approach for the detection/exclusion of conditions which are not suitable for physiotherapy.
- An ongoing research project by IFOMPT aims to develop an evidence based clinical reasoning framework which will hopefully help to shed light into current uncertainties about which red flags are informative for detecting serious spinal pathologies.
- An alternative approach to determine the presence of concurrent pathological processes which may have an impact on the future patient's health status and be predictive of negative treatment outcomes has been introduced by George et al. (2015).

Chapter Four

Keep/refer decision making abilities of qualified physiotherapists and physiotherapy students.

4.1. Introduction

Chapter three reviewed the latest research findings and up to date evidence to either rule in or out the presence of serious medical conditions of the vertebral column, primarily of the lower back.

Chapter four will cover the following aspects:

- An overview and discussion of common teaching methods for improving clinical decision making competencies within health care related education.
- An overview of different research methods which are utilized to examine keep/refer decision making abilities and other clinical decision making competencies within health care related research.
- An overview of existing literature which has already assessed the keep/refer decision making abilities of qualified physiotherapists and physiotherapy students.
- An overview of existing studies that have already assessed the attitude of different stakeholders towards the importance of physiotherapists to make keep/refer decision and to recognise the presence of serious pathologies.

4.2. Overview of teaching methods for improving clinical reasoning and decision making competencies within health care related education.

While it is acknowledged that a wide variety of different teaching methods exists, three main teaching methods are commonly discussed within the health care education literature:

- Lecture-based format (David et al., 1998; Lowe, 2011; Schmidt et al., 2015).
- Case-based method (Tärnvik, 2007; Nelson, 2010; Thistlethwaite et al., 2012).
- Problem-based method (Srinivasan et al., 2007; Tärnvik, 2007).

The lecture-based method has been a prevalent and established teaching form for centuries (Lowe, 2011, Schmidt et al., 2015). More recently, however, its usefulness for the education of health professionals has been questioned (David et al., 1998; Lowe, 2011; Schmidt et al., 2015; Schwartzstein and Roberts, 2017). Lowe (2011) described that a major disadvantage of lecture-based learning is its lack of relevance. The author concluded that '... the information delivery model is not reflective of situations they [the students] will encounter in real life once leaving school' (Lowe, 2011:8). The lecture-based format only includes passive acquisition of information which is then subsequently assessed by the amount of information that has been stored by the student and does not examine whether learners or students are able to put this information into use in the clinical, real world setting or context (Lowe, 2011). Moreover, Lowe (2011) and Schmidt et al. (2015) argued that another shortcoming of the lecture-based format is that students can only keep their attention for roughly 20 minutes when listening to a lecture. Yet, a typical lecture, for instance, at the University of Applied Sciences in Krems/Austria lasts at least 45 minutes (IMC FH Krems, 2016).

As opposed to the lecture-based format, two other teaching models have been developed:

- a) Case-based learning (CBL), which was introduced at the beginning of the 20th century at the University of Edinburgh (Thistlethwaite et al., 2012).
- b) Problem-based learning (PBL), which has been developed more recently in the 1970^s at the McMaster University School of Medicine, Canada (Neufeld and Barrows, 1974).

Although the terms CBL and PBL are sometimes used interchangeably (Nelson, 2010), there are some fundamental differences. Tärnvik (2007:e33) explains that:

... PBL stimulates students to explore the knowledge needed to understand a given phenomenon, whereas the case method [CBL] offers opportunities for familiarization and deepening of knowledge already acquired through lectures and other sources. It should be noted that both approaches emphasize depth of understanding, in PBL promoted by self-generation [student-centred] of knowledge and in the case method by an expert led group discussion [teacher-directed].

Both teaching strategies foster clinical reasoning and decision making competencies within health care and medical education (Schmidt et al., 1996; David et al., 1998; Nelson, 2010; McLean, 2016) and are perceived as effective and valuable models by University students and faculty staff alike (Nelson, 2010; Thistlethwaite et al., 2012). The results of a meta-analysis by Dochy et al. (2003) demonstrated that students from a PBL background were significantly better in applying the acquired knowledge than students who were taught in a more traditional, lecture-based environment. Although the students from a lecture-based background knew in the short term more facts, the students from problem-based curricula were also superior in remembering the acquired knowledge (called enhanced knowledge retention) (Dochy et al., 2003). A systematic review by Thistlethwaite et al. (2012) showed that CBL is widely recognised as an effective teaching method for educating health professionals. On the other hand, the authors pointed out that there is inconclusive evidence whether CBL is more effective in producing better clinicians than other learning types (Thistlethwaite et al., 2012). A main benefit of CBL over PBL, however, is that CBL is less time consuming (Srinivasan et al., 2007; Tärnvik, 2007). This issue was highlighted by Srinivasan et al. (2007) who analysed the preferences of students and members of faculty from three different medical schools in the United States. The general idea of problem-based teaching (open inquiry) was not generally opposed. Yet, it was felt that sometimes an excessive amount of time was needed for preparation and self-studying (which is the principal idea of PBL) and that these methods were less suitable for an already dense curriculum (Srinivasan et al., 2007). In addition, CBL is not (in comparison to PBL) as susceptible to group dysfunction, which is characterized as the '... indifference towards the group discussion and/or a failure to prepare or attend regularly' (Tärnvik, 2007:e34).

Nelson (2010) qualitatively assessed the self-perceived benefits of CBL from the perspective of eight physiotherapy programmes (faculties, members of staff and University students) in the United States. The results of Nelson (2010) showed that CBL is perceived by faculties, members of staff and students as a highly effective strategy to enhance/develop clinical reasoning and decision making competencies and improves the students' differential diagnostic capabilities. Unfortunately, Nelson (2010) did not specify whether the programmes studied were undergraduate, postgraduate, or both. Only eight physiotherapy programmes out of 212 were included, therefore one might

question the generalisability of the results. However, the author argues that after having collected data from six educational facilities, data saturation was reached (Nelson, 2010). Nelson (2010:16) also highlighted the fact that especially in the case of more desired practice autonomy (as this is currently the case in Austria) physiotherapy educational programs are challenged:

... to place more emphasis on clinical decision-making in order to provide entry-level clinicians the tools needed to make sound, accurate differential diagnoses and to treat the patients effectively based on this decision making process.

Moreover, CBL '... meets the needs of physical therapy curricula in preparing physical therapy students to enter the profession' (Nelson, 2010:16), and appears to be an excellent '... strategy for addressing changing clinical environments' (McGinty, 2000:50). Although it is still unclear which teaching method actually produces the better clinicians (Thistlethwaite et al., 2012), the CBL format is generally supported by the literature and is perceived as an effective teaching and learning method for educating health professionals (including physiotherapy students) (McGinty, 2000; Tärnvik, 2007; Srinivasan et al., 2007; Nelson, 2010; Lowe, 2011; Thistlethwaite et al., 2012). Especially in cases of less experienced learners (Srinivasan et al., 2007), CBL seems to be an appropriate educational strategy for improving the clinical decision and keep/refer decision making abilities of undergraduate physiotherapy students in Austria.

4.3. Clinical vignettes as a tool for measuring clinical decision making competencies of health professionals.

In order to analyse clinical decision making abilities of medical professionals, researchers make use of clinical vignettes which are basically concise paper-based or electronic descriptions of actual clinical situations (Peabody et al., 2000). Vignettes imitate real patients with various ailments and a wide range of different, sometimes complex, symptoms. Based on the clinical descriptions within such vignettes, clinicians are then asked to make a decision about either examination procedures, (differential) diagnosis and/or possible treatment options (Peabody et al., 2004). An additional advantage of vignettes is that they can be easily distributed among a large number of clinicians even with different educational backgrounds or from divergent health care

systems as opposed to using the gold standard of standardized patients which is more preferable in small scale studies (Peabody et al., 2004; Converse et al., 2015). Standardized patients, on the other hand, are basically simulated patients or trained actors who simulate an ailment or specific clinical features during an (e.g. doctor's) appointment (Converse et al., 2015). Apart from the aforementioned limitation of their proposed suitability for exclusively small scale studies, there are also other issues which need to be considered. Firstly, the use of standardized patients is more expensive than the application of vignettes, and secondly, training those simulated patients can be relatively time consuming (Converse et al., 2015). The major advantage of standardized patients, on the other hand, is that those who are being examined (the clinicians) do not automatically know that they (their clinical decisions or treatment options, respectively) are being under evaluation which is unavoidable when using vignettes (Veloski et al., 2005). This subsequently reduces the risk of social desirability bias which will be discussed later in this chapter, in section 4.4, on page 81.

Alternative methods of examining clinical decision making competencies within health care related research are medical record abstraction and administrative claims data analysis (Converse et al., 2015). While both procedures have the overall benefit of using already existing data, medical record abstraction can be time and cost intensive when the data set is not electronically available and therefore needs to be extracted manually by experienced researchers (Converse et al., 2015). Above all, when using medical record abstraction, one has to rely on data which has been recorded by others and might therefore be incomplete (Converse et al., 2015). Converse et al. (2015) deem administrative claims to be less useful for assessing clinical decision making competencies as they, most of the time, do not contain detailed information about specific patients' complaints, diagnostic decisions and various referral procedures.

4.4. Keep/refer decision making abilities of physiotherapists and physiotherapy students using clinical vignettes.

A literature search was conducted in order to retrieve studies which have already examined keep/refer decision making abilities of qualified physiotherapists and/or physiotherapy students. Seven medical databases (CINHAL, Medline EBSCOhost, OVID, PubMed, Science Direct, Scopus, and Web of Science) and the grey literature (Google, Google Scholar, Yahoo, and Bing) were searched from the earliest record up to May 2016. Study language was limited to English and German. In order to find eligible studies, the search terms “clinical decision”, “keep/refer decision”, “medical referral”, “red flag screening”, “screening for medical referral” and “differential diagnosis” were used. Each of these search terms were combined with “physiotherapy” and “physical therapy” (in order to account for the different nomenclature in Europe and North America). For studies conducted in German language, the search item “Direktzugang Physiotherapie” (direct access physiotherapy) was also used. This was done because keep/refer decision making abilities of physiotherapists in Germany, Switzerland and Austria are often analysed in the context with future ambitions to implement direct access to physiotherapy. Reference lists of eligible studies which were found during the electronic search were also thoroughly reviewed so that no relevant research paper was missed.

In the end, eight relevant studies could be obtained (table 4.1). All in all, those eight studies examined keep/refer decision making abilities of 5555 qualified physiotherapists and physiotherapy students between 2004 and 2012 using clinical vignettes (Riddle et al., 2004; Childs et al., 2005; Jette et al., 2006; Beyerlein, 2010; Schämann et al., 2011; Vaughn et al., 2011; Cross et al., 2011; Mount, 2012). It should be noted at this stage that the study by Childs et al. (2005) did not explicitly examine keep/refer decision making abilities but rather clinical decision making competencies and overall medical knowledge of qualified physiotherapists and physiotherapy students in the United States. Nonetheless, the research by Childs et al. (2005) used to some extent clinical vignettes and was therefore included in the analysis.

Table 4.1: Summary of studies which examined keep/refer decision making abilities of qualified physiotherapists and physiotherapy students.

Authors	Population	Country	Sample size	Topic/medical problem	Number of vignettes
Riddle et al. (2004)	Physiotherapists working in a private setting or in a hospital	USA	969	Proximal deep venous thrombosis (DVT)	6
Childs et al. (2005)	Physiotherapists and physiotherapy students of the United States Armed Forces	USA	356	Common musculoskeletal pain problems	Not applicable
Jette et al. (2006)	Physiotherapists working in private setting	USA	394	Musculoskeletal, medical non-critical and medical critical conditions	12

Authors	Population	Country	Sample size	Topic/medical problem	Number of vignettes
Beyerlein (2010)	Physiotherapists working in private setting or hospital	Germany	937	Musculoskeletal, medical non-critical and medical critical conditions	12
Schämann et al. (2011)	Physiotherapists working in private practice or hospital	Switzerland	2137	Musculoskeletal, medical non-critical and medical critical conditions	12
Vaughn et al. (2011)	Final year doctor of physical therapy students	USA	159	Musculoskeletal, medical non-critical and medical critical conditions	12
Cross et al. (2011)	Physiotherapists assisting sporting events	USA	389	Acute sporting injuries and serious medical conditions	17
Mount (2012)	Physiotherapists working in different practice settings	USA	214	Musculoskeletal, medical non-critical and medical critical conditions	11

A more detailed description of the studies can be found below:

In 2004, Riddle and colleagues conducted a study where 969 physiotherapists working in a private setting or in a hospital in the United States completed 6 concise, clinically validated (by orthopaedic surgeons and experienced physiotherapists) vignettes. Based on the clinical prediction rule by Wells et al. (1997) to determine the absolute risk of a proximal deep venous thrombosis (PDVT) of the lower extremities, physiotherapists were asked to estimate, based on the signs and symptoms, if there was either a high, moderate or low risk of a PDVT. The results of this study revealed that the physiotherapists tested had considerable problems to determine especially if a patient had a high risk of a PDVT of the lower limbs which requires immediate medical examination and management. For the two high risk cases, 87% and 64% of the physiotherapists respectively underestimated the risk of the patients suffering from a PDVT and even more worrisome, 32% and 27% respectively would not have consulted a medical doctor at all. These results are of particular concern since missing a PDVT might lead to pulmonary embolism causing a potentially life threatening/emergency situation (Riddle et al., 2004).

The results of Riddle et al. (2004) are in line with two recent studies in Australia which revealed that there appears to be an unexpected lack of knowledge in both physiotherapy students and clinical educators about the existence of diagnostic and therapeutic CPRs (including the one to identify PDVT) (Knox et al., 2015; Knox et al., 2016).

Childs et al. (2005) assessed clinical competencies of 182 qualified physiotherapists of the United States Armed Forces with and without additional specialisation in either orthopaedic and/or sports physical therapy and a random sample of 174 physiotherapy students who, at the time of the study, were in the final phase of completing either a doctoral programme or a master degree. Using a standardized examination protocol which was taken from previous research to assess musculoskeletal knowledge and clinical decision making abilities of new graduates from medical school (Freedman and Bernstein, 1998; Matzkin et al., 2005) and of a variety of medical specialists and medical students (Matzkin et al., 2005) data analysis revealed that qualified physiotherapists and physiotherapy students scored higher than medical students, medical interns and all

medical specialists except for orthopaedists (Childs et al., 2005). This study demonstrated that physiotherapists and physiotherapy students (Doctoral and Master) are basically capable of independently making accurate clinical decisions. However, generalization of the results must be made with caution. Physiotherapists and physiotherapy students in this study were members of the United States Armed Forces who usually receive additional speciality training in neuromusculoskeletal examination and triage and therefore represent a very distinct and specialized group within the physiotherapy profession (Moore et al., 2005).

In 2006, Jette and colleagues completed a study where qualified physiotherapists working in private practice in the United States were given 12 hypothetical vignettes which were validated by expert physiotherapists. These 12 vignettes contained clinical situations classified as either musculoskeletal, medical non-critical or medical critical. Participating physiotherapists were given 3 options: Either to provide physiotherapeutic management without additional medical evaluation (keep), to treat the patient but also refer the patient for additional medical check-up (keep and refer) or to refer the patient without physiotherapeutic management (refer). Of a random sample of 1000 physiotherapists, 394 completed the survey. Results indicated that only approximately 50% of the volunteering physiotherapists could correctly identify all medical critical cases (which required immediate referral to a physician). Moreover, in two out of three medical critical cases, less than 80% chose to refer the patient without any physiotherapeutic intervention. Especially worrying for the authors of this study, for the three medical critical cases, 11% (3%, 7% and 1% for each of the three cases, respectively) of the physiotherapists being tested chose not to consult a medical practitioner at all (Jette et al., 2006). The authors concluded that the professional physiotherapy education should put more emphasis on teaching physiotherapists to identify serious medical pathologies which require immediate medical attention and where physiotherapy management is clearly not indicated.

After the research by Jette et al. (2006), further studies using similar methodology were conducted in order to assess the keep/refer decision making abilities of qualified physiotherapists in Germany (n=937) (Beyerlein, 2010), Switzerland (n=2137) (Schämann et al., 2011), the United States (n=214) (Mount, 2012) and of doctoral

students (n=159) (DPT) in the United States (Vaughn et al., 2011). In line with the results by Jette et al. (2006), it became obvious that physiotherapists in different WCPT member countries and DPT students in the United States still find it difficult to accurately detect the presence of conditions which require (immediate) medical attention and, if remain undetected, might have severe negative effects on the patient's health (Beyerlein, 2010; Schämann et al., 2011; Vaughn et al., 2011; Mount, 2012). Results also indicated that variables such as more years of work experience (Beyerlein, 2010; Vaughn et al., 2011; Schämann et al., 2011), additional/higher and specialized postgraduate education (Jette et al., 2006) and working in an outpatient setting (Mount, 2012) seem to improve physiotherapist's ability to identify severe medical conditions based on clinical vignettes which require a referral for further medical check-up.

In 2011, Cross et al. (2011) created a survey containing 17 cases which was electronically distributed among qualified physiotherapists in the United States who were also members of the American Sports Physical Therapy Association. Cross et al. (2011) examined if physiotherapists were capable of making accurate return to play decisions during sporting events. Study participants were asked to rate if, based on the case descriptions, an athlete could continue its sporting activity or if further medical evaluation might be required (Cross et al., 2011). Results of this study indicated that physiotherapists who are working at sporting events were not sufficiently prepared to assess and detect serious medical conditions and injuries which prohibit further participation in the sporting activity.

The major strength of the study by Childs et al. (2005) was that the authors used a standardized examination material which has already been utilized in previous research (Freedman and Bernstein, 1998; Matzkin et al., 2005). The particular advantage of the studies by Riddle et al. (2004), Jette et al. (2006), Beyerlein (2010), Schämann et al. (2011), Vaughn et al. (2011) and Mount (2012) was that all of their clinical vignettes have been validated by expert physiotherapists and/or medical doctors.

In general, existing literature provides interesting insight in how far qualified physiotherapists and DPT students in several WCPT member countries are capable of recognising serious medical conditions based on clinical vignettes which are not

amendable by physiotherapy but need (at least additional) medical evaluation and/or treatment.

On the other hand, there are some limitations that need to be discussed as well:

The application of vignettes to measure clinical decision making processes within the field of medicine has recently gained popularity (Evans et al., 2015; Rousseau et al., 2015). Vignettes are widely recognised as a valid measurement tool that realistically simulates real life situations (Peabody et al., 2000; Peabody et al., 2004; Evans et al., 2015; Rousseau et al., 2015). Yet, research that examined decision making abilities of physiotherapists and physiotherapy students (Riddle et al., 2004; Vaughn et al., 2011; Mount, 2012) heavily relies on two research papers (Peabody et al., 2000; Peabody et al., 2004) in order to justify their own utilization of clinical vignettes. However, there is also emerging evidence that casts doubt about the uncritical application of vignettes within health care related research. Although not explicitly examining clinical decision making processes or referral strategies, Brunner et al. (2015) demonstrated that there exists a discrepancy between vignettes and real life situations (using simulated patients) when it comes to communication and activity related advice given by physiotherapists. The authors concluded that clinical vignettes may be generally more suitable to investigate other forms of clinical competencies such as treatment options, keep/refer decisions, diagnostic abilities (Brunner et al., 2015). In addition, Veloski et al. (2005) raised the concern that the answers given by clinicians within clinical vignettes tend to represent rather idealistic responses and not necessarily the most realistic ones (= social desirability bias). Veloski et al. (2005) argued that, for instance, a lack of time during a busy day at the clinic may prompt a clinician to simply skip some important examination procedures which they, however, should/would normally conduct (and, of course, theoretically do when being asked to complete a hypothetical case within a vignette) (Veloski et al., 2005). The limitations of vignettes as an instrument to accurately simulate clinical decision making abilities was further highlighted in a study by Mohan et al. (2014). Their results revealed poor correlation between transfer decisions based on vignettes as compared to real trauma patients in an emergency department (Mohan et al., 2014).

Apart from acknowledging that vignettes do not necessarily predict clinical decisions in the real world of clinical practice, the decisions based on the vignettes themselves (e.g. referral or diagnostic options, different treatment approaches) leave sometimes ample room for interpretation. For instance, the 12 cases by Jette et al. (2006) were validated on a second occasion by medical doctors (Vaughn et al., 2011). Although most of the time, the panel of medical doctors could unanimously agree whether a patient needed further investigation, or not, there were still some vignettes that did not reach 100% consensus (Vaughn et al., 2011) [a more detailed description and critical discourse of different answer options of individual vignettes by Jette et al. (2006) will follow in the discussion section in chapter five, section 5.4., page 116]. In the research by Mount (2012), only two cases out of 11 had 100 % consensus during the validation phase.

Studies by Riddle et al. (2004), Jette et al. (2006), Beyerlein (2010), Cross et al. (2011), Vaughn et al. (2011), Schämann et al. (2011) and Mount (2012) give a relatively solid overview how physiotherapists and physiotherapy students make keep/refer decisions. However, the varying response rates make generalizability rather difficult. While Riddle et al. (2004) had a response rate of 65%, Vaughn et al. (2011) only achieved a rate of return of less than five percent. Having said this, Vaughn et al. (2011) were not able to send their surveys directly to the participants but instead had to rely on individual Universities to further distribute the vignettes among the final year DPT students. On the contrary, Riddle et al. (2004), Jette et al. (2006), Schämann et al. (2011), Mount (2012) and Beyerlein (2010) directly sent their surveys to individual physiotherapists.

The last point of discussion applies to non response bias. Within their study, Jette et al. (2006) and Vaughn et al. (2011) concluded that maybe only clinicians completed the survey who felt competent enough to make an accurate keep/refer decision. On the other hand, physiotherapists who had little confidence in their ability to distinguish between critical and traditional (benign) cases might have simply declined participation (Jette et al., 2006; Vaughn et al., 2011). Vaughn et al. (2011), who examined keep/refer decision making abilities of DPT students in the United States, even hypothesized that individual Universities, who knew about a possible lack of knowledge/training of their students, might have been reluctant to distribute the survey.

4.5. Attitude of different stakeholders towards the importance of qualified physiotherapists and physiotherapy students to make accurate keep/refer decisions and to recognise the presence of serious pathologies.

Apart from capturing the level of keep/refer decision making competencies of qualified physiotherapists and physiotherapy (DPT) students, there have also been some research interests in assessing the attitude of different stakeholders towards the importance of qualified physiotherapists and physiotherapy students to make accurate keep/refer decisions and to recognise the presence of serious pathologies:

A literature search was conducted in order to retrieve studies which have already evaluated the attitude of different stakeholders (physiotherapists and physicians) towards keep/refer decision making and red flag screening of qualified physiotherapists and/or physiotherapy students. Seven medical databases (CINHAL, Medline EBSCOhost, OVID, PubMed, Science Direct, Scopus, and Web of Science) and the grey literature (Google, Google Scholar, Yahoo, and Bing) were searched from the earliest record up to December 2017. Study language was limited to English and German. In order to find eligible studies, the search terms “attitude” and “belief” were used. Each of these search terms were combined with “physiotherapy” and “physical therapy” (in order to account for the different nomenclature in Europe and North America). In addition, these terms were combined with “primary care”, “direct access”, “red flag screening”, “keep/refer decision making” and “screening for medical referral”. Reference lists of eligible studies which were found during the electronic search were also thoroughly reviewed so that no relevant research paper was missed.

Six relevant studies which examined the attitude towards keep/refer decision making and recognition of serious pathologies from the perspective of qualified physiotherapists in the United States (Donato et al., 2004; Clark, 2007), of qualified physiotherapists in Austria (Knipp, 2008; Sorge, 2017) and Switzerland (Scheermesser et al., 2011) and of physicians in the United Kingdom (Suckley, 2012) were retrieved.

A short description of the studies can be found below.

Donato et al. (2004) found out that physiotherapists in the State of Ohio/USA who work as primary care clinicians pay the identification of signs and symptoms of conditions

which are not suitable for physiotherapy slightly more attention than their colleagues who work as non-primary care clinicians (Donato et al., 2004). The main limitation of the study by Donato et al. (2004) was that it only included physiotherapists from the State of Ohio. Hence, a generalisability of the results to physiotherapists from the remaining United States of America is problematic.

Clark (2007) used a random sample of 1108 qualified physiotherapists who were members of the American Physical Therapy Association (APTA). In conclusion, the majority of respondents clearly deemed the ability to independently decide if a patient is suitable for physiotherapy to be highly important for physiotherapists who work in both, direct and non direct access systems (Clark, 2007). One limitation of the research by Clark (2007) was that it only included physiotherapists with more than 10 years of experience and who were members of the APTA. Hence, the results can only be generalised to more experienced clinicians and to members of the APTA. In addition, Clark (2007) highlighted the issue of non-response bias. Clark (2007) concluded that it is unknown if non-respondents might have had a different attitude towards making independent keep/refer decisions and screening for serious pathologies.

In 2008, Knipp conducted a survey amongst more than 4000 qualified physiotherapists in Austria. 712 physiotherapists (17.6%) completed the survey. The aim of this study was to explore the attitude of qualified Austrian physiotherapists towards the implementation of a direct access system to physiotherapy in Austria. Results demonstrated mixed responses towards Austrian physiotherapists' self-perceived confidence of being capable to recognise the presence of serious pathologies within their patients' clinical presentation (Knipp, 2008). The majority of respondents highlighted the need for additional, postgraduate training/education to learn how to recognise the presence of serious pathologies which require a medical referral (Knipp, 2008).

In 2011, Scheermesser and colleagues conducted a survey among 7874 qualified physiotherapists in Switzerland. The background of this survey was to assess the attitude of Swiss physiotherapists towards the implementation of a direct access system to physiotherapy in Switzerland. 2137 physiotherapists completed the survey. The majority of respondents (86%) approved the efforts to implement a direct access system

to physiotherapy. The results also demonstrated the importance (from the perspective of qualified physiotherapists) of having the appropriate knowledge to screen patients for the presence of serious pathologies in the case of advanced practice autonomy (Scheermesser et al., 2011).

In 2012, Suckley conducted a Delphi survey among 72 physicians (from the medical fields of rheumatology, neurology, neurosurgery, general practice, orthopaedic surgery, and rehabilitation medicine) in the United Kingdom. The aim of this study was to ascertain clinical core competencies for physiotherapists working as extended scope practitioners in the United Kingdom from the perspective of medical specialists. Of the original 72 physicians, 61 took part in the study. In the end, red flag screening was regarded as core competency by 98% of respondents.

In 2017, the results of a survey among 6219 qualified physiotherapists in Austria were published (Sorge, 2017). 2065 physiotherapists completed the survey. 94.8% voted in favour of more practice autonomy. More than 90% also stated that the Austrian physiotherapy association should continue its political effort to promote more practice autonomy for physiotherapists in Austria (Sorge, 2017). Similar to the results by Knipp (2008) and Scheermesser et al. (2011), Austrian respondents highlighted the need for additional qualifications in order to be able to recognise the presence of serious pathologies which require a medical referral (Sorge, 2017).

4.6. What is already known and what are the gaps in the literature with special relevance for Austria?

There have been various studies which examined the keep/refer decision making abilities of qualified physiotherapists working in different health care settings (Mount, 2012), with different areas of expertise, varying years of experience or distinct postgraduate qualifications (Riddle et al., 2004; Jette et al., 2006; Beyerlein, 2010, Schämann et al., 2011; Cross et al., 2011; Mount, 2012). The keep/refer decision making abilities of DPT students in the United States (Vaughn et al., 2011) and clinical decision making competencies of physiotherapists of the United States Armed Forces (Childs et al., 2005) have also been assessed. Moreover, previous research has evaluated the

importance of recognising serious pathologies from the perspective of physicians in the United Kingdom (Suckley, 2012) and of qualified physiotherapists in the United States (Donato et al., 2004; Clark, 2007), Switzerland (Scheermesser et al., 2011) and Austria (Knipp, 2008; Sorge, 2017). Furthermore, clinical vignettes have been shown to be reliable tools for measuring clinical decision making competencies of health professionals (Peabody et al., 2000; Peabody et al., 2004; Converse et al., 2015). In addition, the CBL format is generally supported by the literature and is perceived as an effective teaching and learning method for educating health professionals including physiotherapy students (McGinty, 2000; Tärnvik, 2007; Srinivasan et al., 2007; Nelson, 2010; Lowe, 2011; Thistlethwaite et al., 2012).

In light of recent developments within the Austrian health care sector (Physio Austria, 2014), the desire from the Austrian physiotherapy association to implement a direct access system to physiotherapy in Austria (Baumgartner, 2013; Bauer-Horvath, 2015; Sorge, 2017) and changes within the mandatory learning outcomes in the case of direct access to physiotherapy in Austria (Eckler et al., 2017), the following four research gaps with special relevance for Austria were identified:

- **Research gap one:** So far, the keep/refer decision making competencies of Austrian final year undergraduate physiotherapy students within Europe have not been assessed.
- **Research gap two:** What is the opinion and attitude of different stakeholders in Austria (undergraduate physiotherapy students and physicians) towards Austrian physiotherapists making independent keep/refer decisions and screen patients for the presence/absence of serious pathologies as part of the undergraduate education and profession?
- **Research gap three:** Which clinical examination procedures do Austrian medical doctors believe every qualified physiotherapist should be capable of?
- **Research gap four:** The feasibility, acceptability and potential effectiveness of a CBL educational intervention which aims to improve the keep/refer decision making competencies of Austrian final year undergraduate physiotherapy students has not been assessed.

➤ In order to address these four research gaps, an explanatory sequential mixed-methods research design (Creswell, 2006) was carried out.

Perspective of patients

It is acknowledged that all stakeholder perspectives would need to be considered prior to proposals for changes in professional practice standards or policies; including consultations with current service users/patients.

This thesis, however, is explicitly concerned with the pedagogical issue of professional education for undergraduate physiotherapy students on this specified topic.

This thesis is contributing towards documenting one specific part of that knowledge base in depth, rather than attempting to cover the wider perspectives of practice and service delivery at a more superficial level.

Consequently, a survey among patients will not be carried out as part of this thesis.

A discussion about the inclusion of the patients' perspective in future studies, especially in the context of increased practice autonomy for Austrian physiotherapists, is described in chapter nine, section 9.2, page 204 of this thesis.

4.7. Ethical approval

Overreaching ethical approval for this doctoral programme of studies was obtained from the Manchester Metropolitan University Ethics Committee 1390 (Faculty of Health, Psychology and Social Care) (Appendix 2) and from the University of Central Lancashire Ethics Committee STEMH 435 (School of Health Sciences) (Appendix 3).

The reason for two ethical approval documents from two different British Universities is that the PhD student started his doctoral studies at the University of Central Lancashire in 2015. After one year, the PhD student transferred, together with his director of studies, to Manchester Metropolitan University.

Local research permission for individual studies which form chapter five, six and seven of this thesis was obtained using the following procedures:

- For the cross-sectional survey among European final undergraduate physiotherapy students in chapter five, the PhD student obtained research permission from individual European Universities before surveying students. Three Universities from Finland required additional written permission from their own institutions (Appendices 4-6). The remaining Universities did not require additional research approval as ethical approval from Manchester Metropolitan University and the University of Central Lancashire was deemed sufficient. Contact persons from individual European Universities then acted as gatekeepers and distributed the surveys among final year undergraduate physiotherapy students.
- For the survey among Austrian medical doctors in chapter six, the Austrian medical council was contacted prior the start of the study and oral permission to distribute a survey among Austrian medical doctors was obtained.
- For the mixed methods randomised pilot study in chapter seven, heads of the 12 physiotherapy schools in Austria were contacted via phone. The PhD student explicitly asked for the need for additional local ethical approval. The heads of Austrian physiotherapy schools confirmed that ethical approval from the Manchester Metropolitan University and from the University of Central Lancashire was sufficient.

4.8. Summary of chapter four

- The CBL method is the preferred educational strategy to improve clinical decision making competencies of health professionals and students.
- Clinical vignettes are generally regarded as a valid research tool to assess clinical decision making competencies of health care professionals and are easily distributed.
- Previous research has revealed weaknesses of qualified physiotherapists from several WCPT member countries (the United States, Switzerland and Germany) and DPT students from the United States to make accurate keep/refer decisions and recognise serious pathologies based on clinical vignettes.

- Previous research has already evaluated the importance to recognise serious pathologies from the perspective of medical specialists in the United Kingdom and of qualified physiotherapists in the United States, Switzerland and Austria.
- In light of the desire from the Austrian physiotherapy association for increased practice autonomy, four research gaps, which have special relevance for physiotherapy undergraduate training in Austria, were identified. The research gaps will be addressed in chapter five, six and seven of this thesis.

Chapter Five

Keep/refer decision making abilities of Austrian final year undergraduate physiotherapy students within Europe: A cross sectional survey using clinical vignettes.

5.1. Introduction

Chapter five addresses objectives II and III of this thesis:

- II. A cross-sectional study (quantitative data) using clinical vignettes assesses the current level of keep/refer decision making competencies of Austrian final year undergraduate physiotherapy students within Europe.
- III. Using web-based-surveys (quantitative data) to get insight into the opinion and attitude of Austrian undergraduate physiotherapy students towards independent keep/refer decisions and the recognition of serious pathologies as part of the physiotherapy education and profession in Austria.

In addition, chapter five addresses the following issues:

- Are European final year undergraduate physiotherapy students in general capable of making accurate keep/refer decisions based on clinical vignettes?
- Are final year undergraduate physiotherapy students from direct access countries more thoroughly trained to detect serious medical pathologies based on clinical vignettes?

[Parts of chapter five have been published in the peer-reviewed journal European Journal of Physiotherapy. The abstract is attached as Appendix 32 on page 317 of this thesis. The original research paper can be accessed online using the following link:

<https://doi.org/10.1080/21679169.2017.1408682>

5.2. Methods

5.2.1. Study Design

A cross sectional design was used to assess the current level of keep/refer decision making abilities of final year undergraduate physiotherapy students who were at the time of the study studying at a member University of the European Network of Physiotherapy in Higher Education (ENPHE). The methods, results and discussion sections adhere to the STROBE statement (Vandenbroucke et al., 2007).

5.2.2. Setting

Initially, the official representative of Austria within ENPHE (Dr Ursula Eckler from the University of Applied Sciences in Vienna) was so kind as to inform other ENPHE member representatives during an ENPHE conference in autumn 2015 about the upcoming project. ENPHE University e-mail addresses were obtained from the official ENPHE homepage. Individual Universities were then contacted in written form in December 2015 via e-mail (Appendix 7) explaining the purpose of the project and inviting them to take part in the study. Those Universities that did not respond to the first e-mail received a second, identical invitation via e-mail at the end of January 2016. Responding Universities were asked to indicate their graduation date(s) to ensure that the distribution of the vignettes would take place as close as possible to the day of their graduation. Survey distribution and data collection took place between May 2016 and February 2017. There was no follow up and students received the link for the survey only once.

5.2.3. Participants

The target population involved final year undergraduate physiotherapy students from 183 ENPHE member Universities (including six Austrian Universities) in 28 European countries. A convenience sample of volunteering students was used for the analysis. Students from ENPHE member Universities were chosen for the following reasons: On its homepage, the European Network of Physiotherapy in Higher Education promotes ‘... research projects between physiotherapy educational institutions’ (ENPHE, 2018:online) and aims to ‘stimulate the development of a European dimension in physiotherapy

educational curricula' (ENPHE, 2018:online). Therefore, it was assumed that ENPHE member institutions and students were more likely to participate in this study than non ENPHE member universities in Europe.

5.2.4. Variables

Independent variables for the current project were individual ENPHE member countries and different access systems to physiotherapy service (direct versus non-direct versus direct, but only for the private sector) within Europe.

Dependent variables were the mean and median percentages as well as 100% percent of correct keep/refer decisions within three different categories musculoskeletal, medical non-critical, medical critical).

Additional outcome variables were the general attitude, personal opinion and perception of Austrian final year undergraduate physiotherapy students towards keep/refer decision making and screening for serious pathologies as part of their undergraduate education and profession in general.

5.2.5. Study/Sample size

The Universities' willingness to participate and actual response rate of final year undergraduate physiotherapy students were impossible to predict. As a consequence, a convenience sample of ENPHE final year undergraduate physiotherapy students was included in the study. This is in line with previous research by Vaughn et al. (2011) who used an almost identical approach in order to examine keep/refer decision making abilities of final year DPT students in the United States.

5.2.6. Data sources/measurements

In order to assess the keep/refer decision making abilities of final year undergraduate physiotherapy students within Europe, an online survey containing 12 vignettes was created. These vignettes have already been used in previous studies on qualified physiotherapists in Switzerland (Schämann et al., 2011), Germany (Beyerlein, 2010), and the United States (Jette et al., 2006) and on doctoral students in the United States (Vaughn et al., 2011) (Appendix 8).

The vignettes used (with permission) for this study have already been validated on two separate occasions by expert physiotherapists (Jette et al., 2006) and a panel of medical doctors (Vaughn et al., 2011).

In order to investigate the students' opinion and attitude towards keep/refer decision making and screening for serious pathologies as part of their education and profession, Austrian students were additionally asked to fill in a questionnaire immediately after having completed the 12 vignettes. Due to the lack of availability of similar questionnaires and the overall limited literature about this specific topic, the questionnaire for Austrian students was developed as a bespoke instrument for the purposes of this PhD programme of work with the feedback from the supervisory team. Having said this, the questionnaire by Clark (2007) also provided some initial ideas about what kind of questions might need to be included. The final version of the questionnaire for the current study was subdivided into three main categories:

- 1) The students' experience with (the completion of) the 12 vignettes.
- 2) The undergraduate education plus clinical placements.
- 3) The physiotherapeutic profession in general (Appendix 9).

As this questionnaire covered several different dimensions which were independent from each other and the majority of questions could be answered with a simple yes or no, a specific scale for later analysis was not used. Scales have the major advantage that, in the end, a summary score can be obtained which then gives the researcher the opportunity to, for instance, observe an overall positive or negative attitude towards a particular topic within the study sample (Portney and Watkins, 2009). A Likert Scale, for example, is a commonly used construct to receive insight into the participants' (possibly) diverse attitudes and/or values (Portney and Watkins, 2009). For a Likert scale, it is recommended to use a substantial amount of questions '... usually 10-20, that reflect an equal number of both favourable and unfavourable attitudes' (Portney and Watkins, 2009:340). Even though three questions within the current survey resembled a Likert scale in their appearance (four possible answer options), these queries neither asked about any values or attitudes nor were they all structured around one specific characteristic (Appendix 9).

5.2.7. Survey and questionnaire pilot testing

It is generally advised that surveys and questionnaires should be pilot tested, preferably on five to ten subjects taken from the target population (Portney and Watkins, 2009). However, the development of the questionnaire for Austrian final year undergraduate physiotherapy students took place at a time (at the end of 2015), when the prospective candidates were still studying in the fifth semester and not yet part of the target population. As a direct consequence, pilot testing in its traditional form could not be carried out.

Instead, each member of the supervisory team received the preliminary final version of the descriptive survey and was asked to provide feedback for the matters of clarification, wording and sequencing of the questions.

The 12 vignettes which needed to be completed by all European undergraduate physiotherapy students were used in exactly the same sequence as previously done by Jette et al. (2006), Beyerlein (2010) and Vaughn et al. (2011). Additional pilot testing was therefore not necessary.

5.2.8. Ethical considerations

Individual universities and all students were assured in written form as part of the study description (Appendix 10 and Appendix 11) (which was distributed along with the link for the actual survey among European final year undergraduate physiotherapy students) that the whole survey was 100% anonymous and individual students and Universities remained completely unidentifiable throughout the whole research and data collection process. In addition, students were made explicitly aware of the fact that participation was completely voluntary and they possessed the right to decline participation and withdraw without any consequences and without the need to give any reasons for doing so. Furthermore, it was explained to the students that the survey and questionnaire would be stored on a password-protected device which would be kept securely in a locked cupboard where access was impossible for anybody except the person responsible for the research.

The complete survey was online and password protected using the online survey tool Lime Survey and Bristol Online Survey Tool (BOS). The online survey tool had to be changed during data collection. The initial survey tool Lime Survey, which had been provided by the University of Applied Sciences in Krems, experienced a major server breakdown and could not be accessed after July 2016. For the remaining data collection, the Bristol Online Survey Tool (BOS) which was provided by Manchester Metropolitan University was used.

Ethical approval for this study was obtained from the Manchester Metropolitan University Ethics Committee 1390 (Faculty of Health, Psychology and Social Care) (Appendix 2) and from the University of Central Lancashire Ethics Committee STEMH 435 (School of Health Sciences) (Appendix 3).

5.2.9.Procedure

Depending on the individual academic calendar of participating Universities, an e-mail containing full description of the study (Appendix 10 and Appendix 11) and the link for the survey was sent over the course of ten months between May 2016 and February 2017. To protect individual student's identity, this e-mail was initially sent to an official contact person from each University and then subsequently distributed among the final year undergraduate physiotherapy students.

After having received the link, volunteering students needed to log into the system giving their pre-/surname and their e-mail address. This optional application offered by the online survey tool Lime Survey was chosen to prevent the students from completing the survey a second time. For reasons of data protection, the names and e-mail addresses could not at, any stage, be not seen or accessed by the author of the study nor could the names or e-mail addresses be linked to the surveys sent back to Lime Survey/BOS. Next, the students automatically received another e-mail containing the link for the actual survey. Participating students were first asked to indicate the country where they completed their undergraduate degree. Then, the students could start the survey. In accordance with earlier methodology (Jette et al., 2006; Beyerlein, 2010; Vaughn et al., 2011; Schämann et al., 2011; Mount, 2012) participating students were

instructed to individually decide (based on the clinical situation described) either to start physiotherapy without additional medical evaluation (keep), treat the patient but also refer him/her for medical examination (keep and refer) or refer the patient for medical check-up without giving any physiotherapeutic intervention (refer). Only one answer option per question was possible. Individual case contents of the 12 vignettes were classified as:

- Musculoskeletal (vignettes: 3, 4, 6, 8, 10)
- Medical non-critical (vignettes: 1, 2, 7, 11)
- Medical critical (vignettes: 5, 9, 12).

Also replicating previously used methodology (Jette et al., 2006; Beyerlein, 2010; Vaughn et al., 2011; Schämann et al., 2011; Mount, 2012), a correct answer for the musculoskeletal cases was to treat the patient without the need for medical referral (keep) or to treat the patient with additional medical check-up (keep and refer). A correct answer for the medical non-critical cases was defined if the student(s) chose to start physiotherapy with additional medical evaluation (keep and refer) or refer the patient without physiotherapeutic management (refer). The sole correct answer for medical critical cases was the decision to send the patient for medical evaluation without physiotherapeutic management (refer).

For the completion of the 12 vignettes, a timer function was set and students were given 15 minutes to complete the task. This was done to simulate actual clinical practice where decisions sometimes need to be done under time pressure. The countdown automatically started once the student entered the page with the 12 vignettes. The 15 minutes are exactly the same amount of time given in previous research (Beyerlein, 2010). Moreover, students were neither able to save the results to complete the survey later, nor to print out the survey. After the completion of the 12 cases, Austrian students were additionally asked to fill in a short questionnaire (no time limit was set for the completion of the supplementary questionnaire).

Students were given a timeframe of two weeks to take part in the study.

5.2.10. Quantitative variables

Completed surveys were automatically sent back to the online survey tool (Lime Survey/BOS). Individual students' responses for each of the 12 cases were then classified as either being correct (Yes) or incorrect (No).

The total number of participating countries and numbers as well as percentages of students from individual ENPHE member countries was also quantitatively assessed.

5.2.11. Statistical methods

Descriptive statistics were used to portray demographic characteristics of participating ENPHE member countries. Replicating previous methodology, descriptive statistics were also used to obtain the mean percentages (plus standard deviation) of correct keep/refer decisions and actual numbers as well as percentages of students who managed to accurately answer all vignettes from a specific category (Jette et al., 2006; Beyerlein, 2010; Schämann et al., 2011; Vaughn et al., 2011; Mount, 2012). As small sample sizes for individual countries were expected beforehand and performance of single students within the current data set varied greatly (which resulted in having some extreme scores), the decision was made to also report the median (25, 75 percentiles) percentages of correct responses. The major advantage of the median is its robustness against outliers as opposed to the mean which is naturally drawn towards extreme values within a distribution (Whitley and Ball, 2002; Portney and Watkins, 2009; Manikandan, 2011).

Actual numbers plus percentages of students who managed to complete 100% of vignettes within a category were reported for all respondents combined and also for singular countries.

Participating countries were additionally divided into three groups depending on whether they either have a direct access system to physiotherapy, non-direct access system to physiotherapy, or direct access system to physiotherapy but only for the private health care sector. Mean (plus standard deviation) and median (25, 75 percentiles) percentages of correct keep/refer decisions for each category depending on different access systems were calculated.

Analysis of the questionnaire for Austrian final year undergraduate physiotherapy students was also conducted by using descriptive statistics.

Data analysis was carried out using the Statistical Package for Social Sciences (SPSS) for windows version 22.0.0.2 (IBM, USA).

5.2.12. Missing data

Only students who completed all 12 vignettes were included in the final analysis.

5.3. Results

5.3.1. Participants

As presented in figure 5.1, from the 183 Universities as listed on the ENPHE homepage, 42 Universities from 17 European countries replied to the invitation. However, of the 42 Universities, six Universities had to be excluded for various reasons: Three Universities did not have a distinct graduation date and therefore sending the survey to the students close to a specific graduation date was impossible. Two Universities required additional comprehensive and complicated application procedures before allowing their students to be included in the study: One University required full, additional ethical approval from its own ethics committee (Appendix 12). For the second University, a contact person from Manchester Metropolitan University or the University of Central Lancashire would have been needed to be present in the country. An additional report would have been necessary to the national Data Protection Authority. Apparently, there were some additional requirements which, however, were not further specified by the contact person (Appendix 13). Another University declined participation in the study because its first undergraduate physiotherapy programme started in 2014 and therefore sending the survey to final year undergraduate physiotherapy students within the timeframe for this study was not feasible (Appendix 14). As a consequence, 36 Universities from 15 ENPHE member countries (table 5.1) were finally included in the study and received depending on individual graduation dates an e-mail, which contained full study description together with the link for the survey, between May 2016 and February 2017.

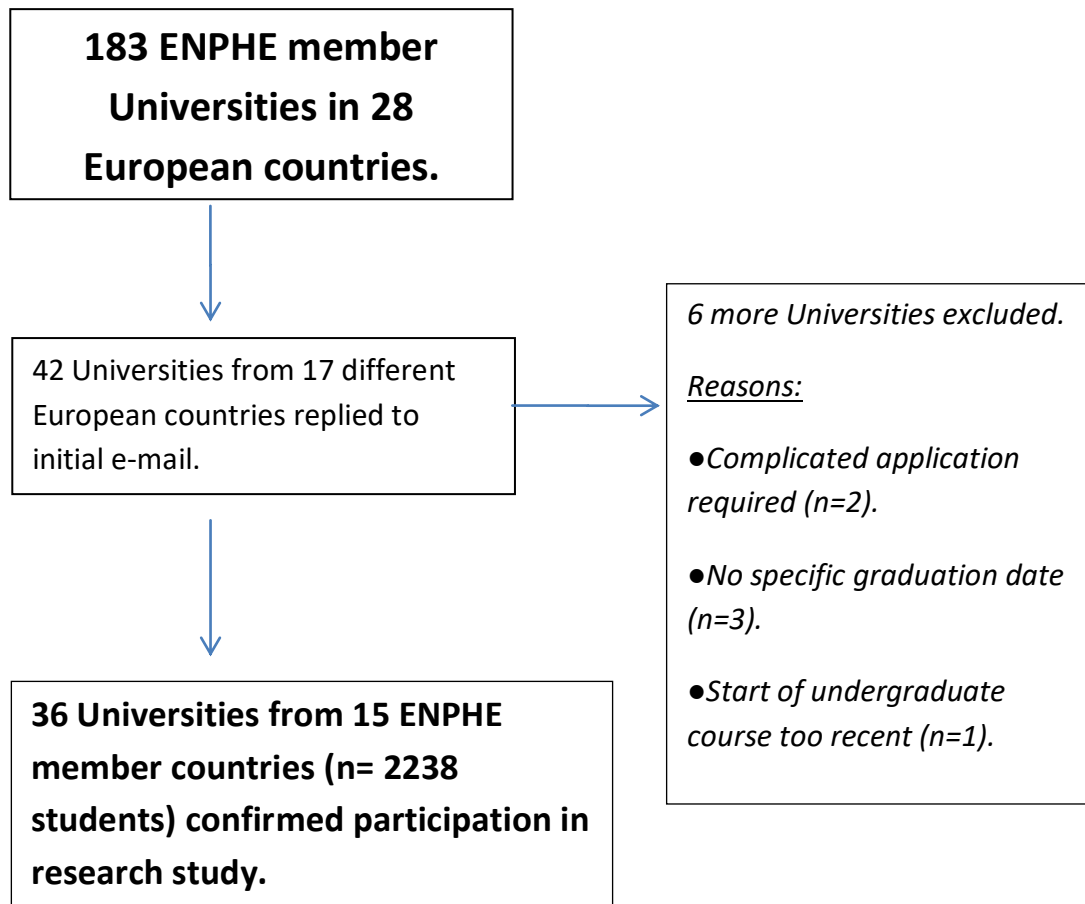


Figure 5.1: Different stages of recruitment.

Table 5.1: Demographic characteristics of participating ENPHE member countries.

ENPHE country	Number of participating Universities	Number of students eligible to take part in the study	Number of students who participated in the study (n)	Response rate (%)
Austria	4	284	13	4.6
Belgium	1	250	0	0
Czech Republic	1	38	4	10.5
Denmark	4	211	16	7.5
Estonia	1	30	10	33.3
Finland	4	151	6	4
Germany	3	71	2	2.8
Latvia	1	10	0	0
Lithuania	3	196	1	0.5
Netherlands	4	410	14	3.4
Norway	1	40	0	0
Spain	3	223	4	1.8
Sweden	3	123	3	2.4
Switzerland	1	111	0	0
United Kingdom	2	90	0	0

A total of 76 students from 10 different European countries completed the survey. Three additional students had to be excluded from the final analysis. Two students failed to complete all 12 cases and one student indicated to have completed his undergraduate degree in France (though no University from France took part in the study). 73 students (3.3%) from 10 ENPHE member countries completed all 12 cases and were therefore included in the final analysis.

5.3.2. Results for European undergraduate physiotherapy students

European undergraduate physiotherapy students made on average an accurate keep/refer judgement for more than 70% of the musculoskeletal and medical non-critical vignettes. Only slightly more than half (on the average) of the medical critical cases were answered correctly (referral without providing physiotherapy intervention) (table 5.2). The results for the medical critical category were notably enhanced when reporting median (instead of mean) percentages of accurate keep/refer judgements.

Table 5.2: Mean and median percentages of correct keep/refer decisions of European undergraduate physiotherapy students combined for each category.

		Musculoskeletal	Medical non critical	Medical critital
N		73	73	73
Mean		75%	72%	52%
Median		80%	75%	67%
Standard deviation		17%	20%	28%
Percentiles	25	60%	50%	33%
	75	80%	75%	67%

Descriptive analysis furthermore revealed that 15.1% (n=11 out of 73) of European final year undergraduate physiotherapy students managed to correctly answer 100% of the cases in the musculoskeletal category. Furthermore, 19.2% (n=14 out of 73) and 11% (n=8 out of 73) of respondents made an accurate keep/refer decision for all cases in the medical non-critical and medical critical category, respectively (Table 5.3).

Table 5.3: Number and percentages of students who made a correct keep/refer decision for 100% of cases within a category.

	Musculoskeletal 100% correct		Medical non critical 100% correct		Medical critical 100% correct	
	No	Yes	No	Yes	No	Yes
N	62	11	59	14	65	8
%	84.9%	15.1%	80.8%	19.2%	89.0%	11.0%

5.3.3. Results in relation to divergent access systems to physiotherapy within Europe

Comparison of the mean and median percentages of accurate keep/refer decisions for the musculoskeletal and medical non-critical vignettes demonstrate only marginal differences between students from either a direct or non-direct access system. The only more obvious divergence is the median percentage within the medical critical category which indicates a convincing tendency towards a higher accuracy of students who were trained in a country with direct access to physiotherapy only for the private health sector (table 5.4).

Table 5.4: Mean and median percentages of correct keep/refer decisions (depending on access system to physiotherapy) for each category.

Access system		Musculoskeletal	Medical non critical	Medical critical
No direct access	N	15	15	15
	Mean	77%	75%	47%
	Median	80%	75%	33%
	Std. Deviation	17%	13%	25%
	Percentiles _____ 25	60%	75%	33%
	_____ 75	80%	75%	67%
Direct access only Private	N	49	49	49
	Mean	75%	72%	54%
	Median	80%	75%	67%
	Std. Deviation	16%	22%	27%
	Percentiles _____ 25	60%	50%	33%
	_____ 75	80%	88%	67%
Direct access	N	9	9	9
	Mean	71%	67%	48%
	Median	80%	75%	33%
	Std. Deviation	23%	13%	38%
	Percentiles _____ 25	60%	50%	17%
	_____ 75	80%	75%	83%

5.3.4. Results of individual ENPHE member countries

The results from individual ENPHE member countries (mean and median percentages of correct keep/refer judgements) demonstrate that participants from the Netherlands (mean: 62%, median: 67%) and Estonia (mean: 60%, median: 67%) achieved the highest scores for the medical critical category (table 5.5, page 104). [Students from Czech Republic had, at first glance, the highest percentages (mean: 67%, median: 67%) within

the medical critical category. [Having said this, due to a standard deviation of zero and identical values for the 25, 50 and 75 percentiles, those results need to be regarded with caution and will be discussed in the limitation section at the end of this chapter.]

Table 5.5: Mean and median percentages of correct keep/refer decisions for each category (per country).

Countries		Musculoskeletal	Medical non critical	Medical critical
Austria	Mean	77%	73%	46%
	Median	80%	75%	33%
	Standard Deviation	16%	12%	26%
	Percentiles	25	75%	33%
		75	75%	67%
Czech Republic	Mean	50%	94%	67%
	Median	50%	100%	67%
	Standard Deviation	12%	13%	0%
	Percentiles	25	81%	67%
		75	100%	67%
Denmark	Mean	81%	64%	46%
	Median	80%	75%	33%
	Standard Deviation	11%	22%	21%
	Percentiles	25	50%	33%
		75	75%	67%
Estonia	Mean	66%	75%	60%
	Median	60%	75%	67%
	Standard Deviation	13%	20%	21%
	Percentiles	25	50%	33%
		75	100%	67%
Finland	Mean	67%	67%	56%
	Median	70%	75%	50%
	Standard Deviation	27%	13%	27%
	Percentiles	25	50%	33%
		75	75%	75%

Germany	Mean		80%	88%	50%
	Median		80%	88%	50%
	Standard Deviation		28%	18%	24%
	Percentiles	25	60%	75%	33%
		75	.	.	.
Lithuania	Mean		100%	100%	0%
	Median		100%	100%	0%
	Percentiles	25	100%	100%	0%
		75	100%	100%	0%
Netherlands	Mean		77%	73%	62%
	Median		80%	75%	67%
	Standard Deviation		13%	21%	32%
	Percentiles	25	60%	69%	58%
		75	80%	81%	75%
Spain	Mean		85%	63%	50%
	Median		80%	75%	50%
	Standard Deviation		10%	25%	43%
	Percentiles	25	80%	38%	10%
		75	95%	75%	92%
Sweden	Mean		80%	67%	33%
	Median		80%	75%	0%
	Standard Deviation		0%	14%	58%
	Percentiles	25	80%	50%	0%
		75	.	.	.

The actual number and percentages of students of single countries who managed to correctly answer all cases from a category was limited (table 5.6). The Netherlands were the sole country who had more than one student (n=3) who could properly answer all three medical critical vignettes (table 5.6).

Table 5.6: Percentage and actual number of students (per country) who made a correct (Yes) or incorrect (No) keep/refer decision for 100% of cases within a category.

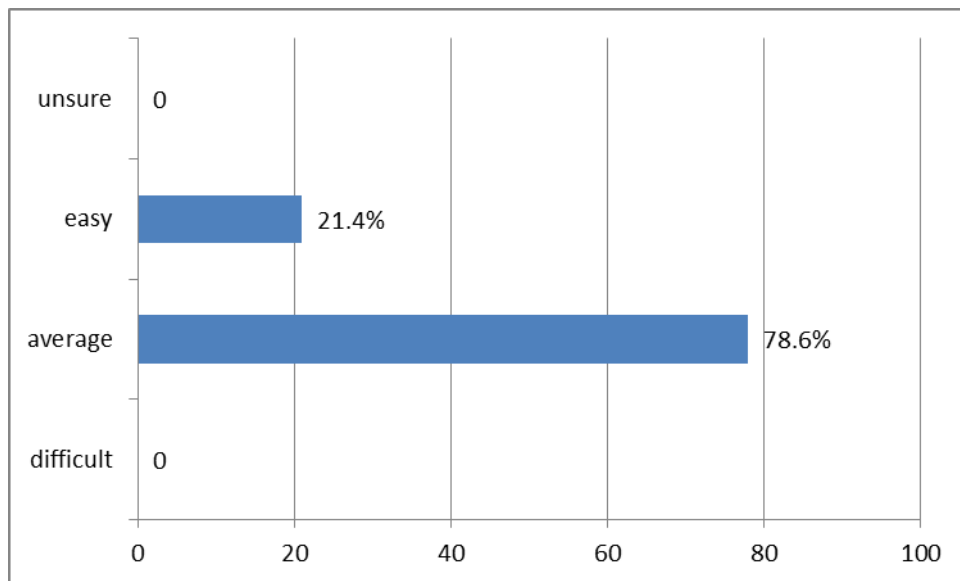
Countries	Percentages (%)	Musculoskeletal 100% correct		Medical non critical 100% correct		Medical critical100% correct	
	Actual Numbers (N)	No	Yes	No	Yes	No	Yes
Austria	N	11	2	12	1	12	1
	%	84.6%	15.4%	92.3%	7.7%	92.3%	7.7%
Czech Republic	N	4	0	1	3	4	0
	%	100.0%	0.0%	25.0%	75.0%	100.0%	0.0%
Denmark	N	13	3	14	2	16	0
	%	81.3%	18.8%	87.5%	12.5%	100.0%	0.0%
Estonia	N	10	0	7	3	9	1
	%	100.0%	0.0%	70.0%	30.0%	90.0%	10.0%
Finland	N	5	1	6	0	5	1
	%	83.3%	16.7%	100.0%	0.0%	83.3%	16.7%
Germany	N	1	1	1	1	2	0
	%	50.0%	50.0%	50.0%	50.0%	100.0%	0.0%
Lithuania	N	0	1	0	1	1	0
	%	0.0%	100.0%	0.0%	100.0%	100.0%	0.0%
Netherlands	N	12	2	11	3	11	3
	%	85.7%	14.3%	78.6%	21.4%	78.6%	21.4%
Spain	N	3	1	4	0	3	1
	%	75.0%	25.0%	100.0%	0.0%	75.0%	25.0%
Sweden	N	3	0	3	0	2	1
	%	100.0%	0.0%	100.0%	0.0%	66.7%	33.3%

5.3.5. Results of the descriptive survey

The analysis of the descriptive survey for final year Austrian undergraduate physiotherapy students revealed that the minority (36%) of respondents felt sufficiently competent to independently identify serious medical conditions in general (figure 5.3).

All respondents from Austria strongly felt that making accurate keep/refer decisions is highly relevant not only for medical doctors but for qualified physiotherapists as well (figure 5.4). The vast majority (86%) deemed screening for severe medical pathologies to be an integral part of every physical examination (figure 5.4) and acquiring the necessary knowledge to do so should be mandatorily taught during an independent lecture/course (figure 5.3). Yet, less than 30% reported to have actually read any specific literature about this particular topic (figure 5.3).

How difficult was it for you to complete the survey?



How difficult was it for you to distinguish between the medical critical and musculoskeletal (medical non critical) cases?

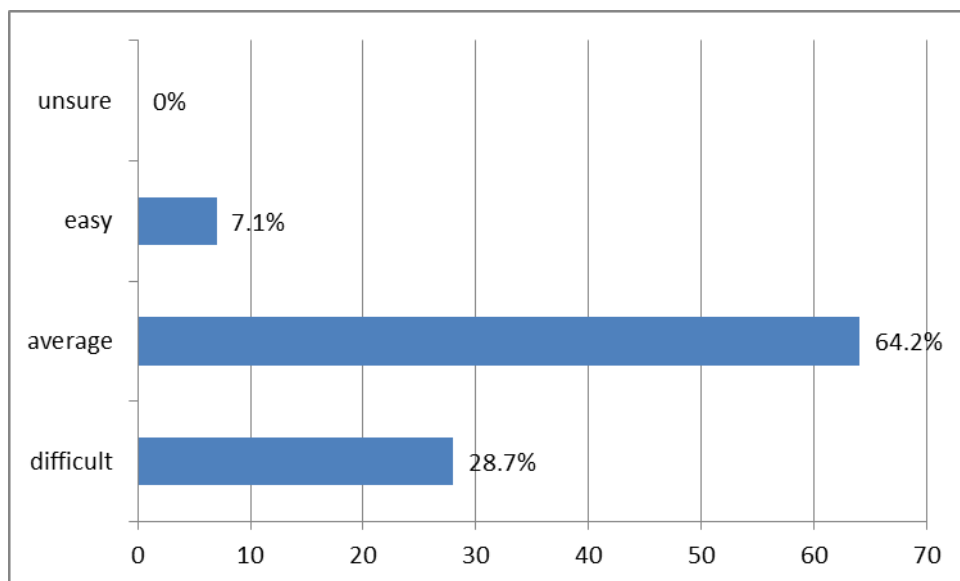
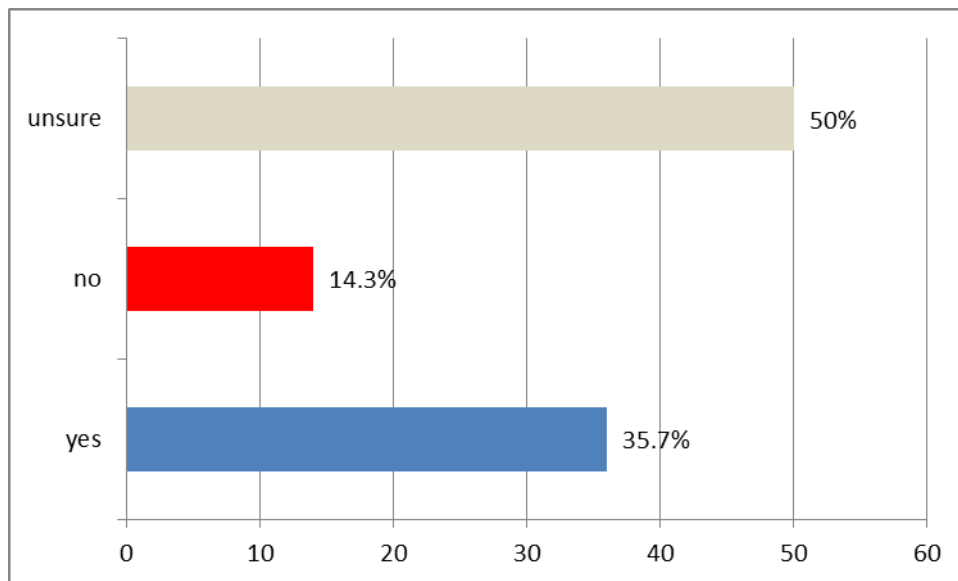
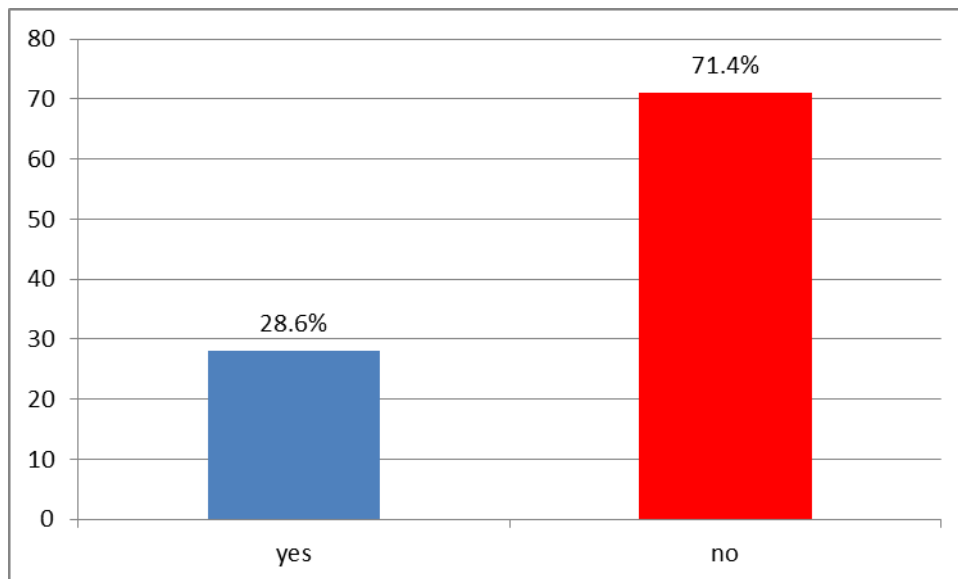


Figure 5.2: Questions concerning the students' experience with (the completion of) the 12 vignettes.

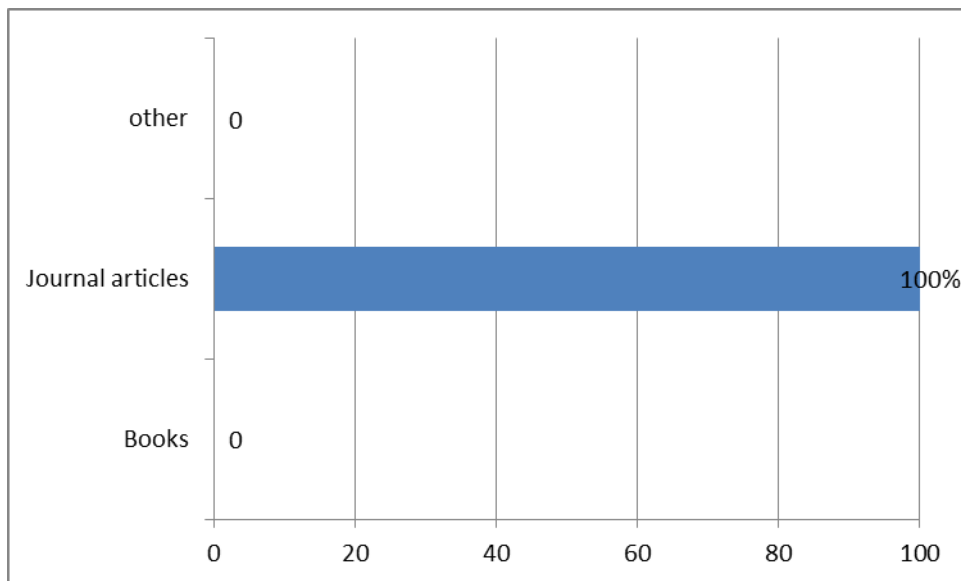
Do you feel sufficiently trained to detect the presence/absence of serious medical pathologies?



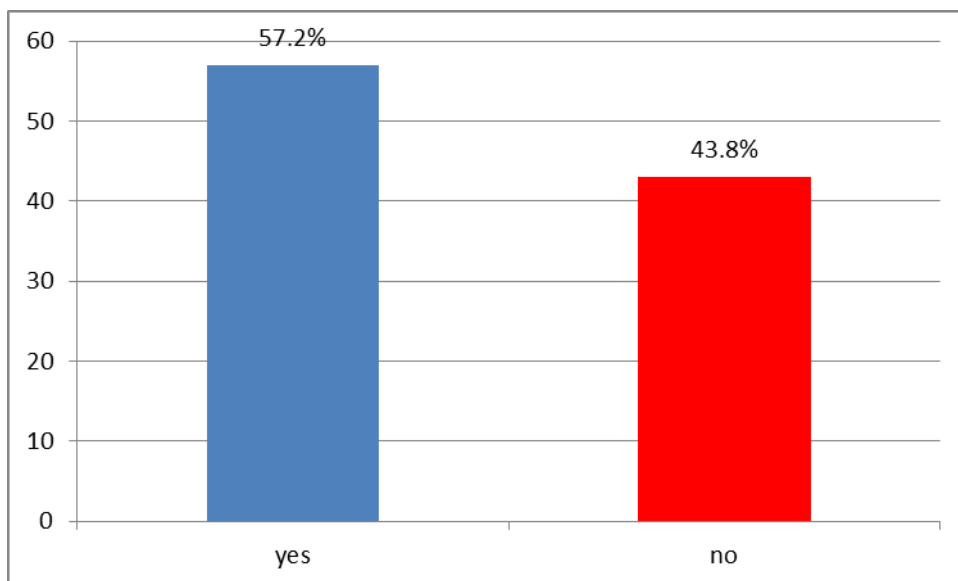
Have you been obliged to read any specific literature about keep/refer decision making abilities (as part of a lecture)?



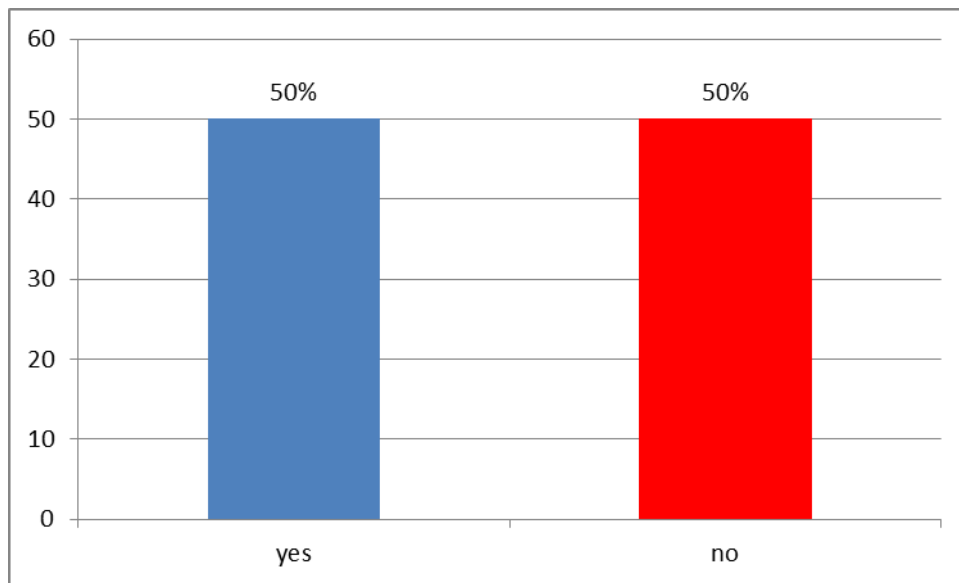
If you have answered the previous question with Yes, please state which kind of literature:



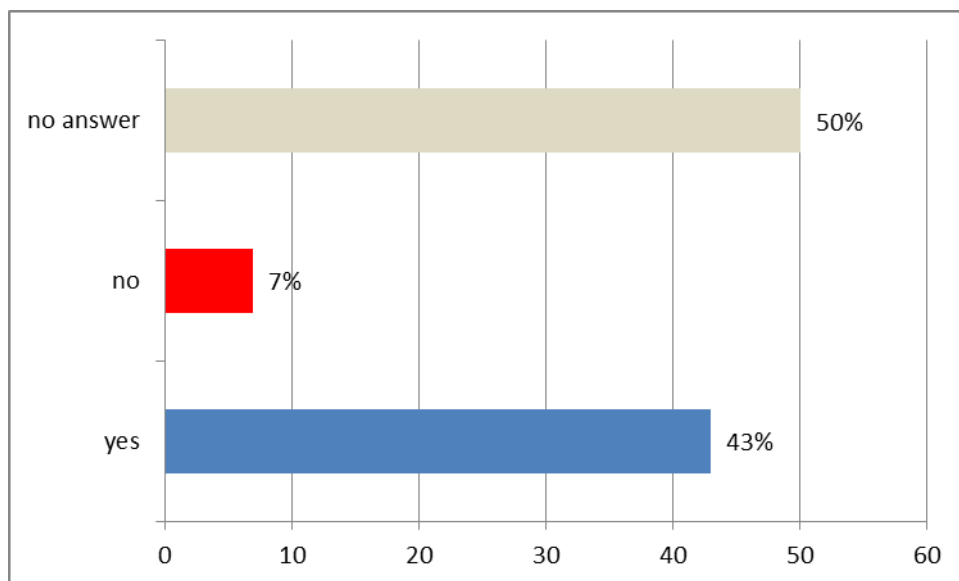
Were keep/refer decision making abilities (screening for serious medical pathologies) an important part of your physical examination process during your clinical internship?



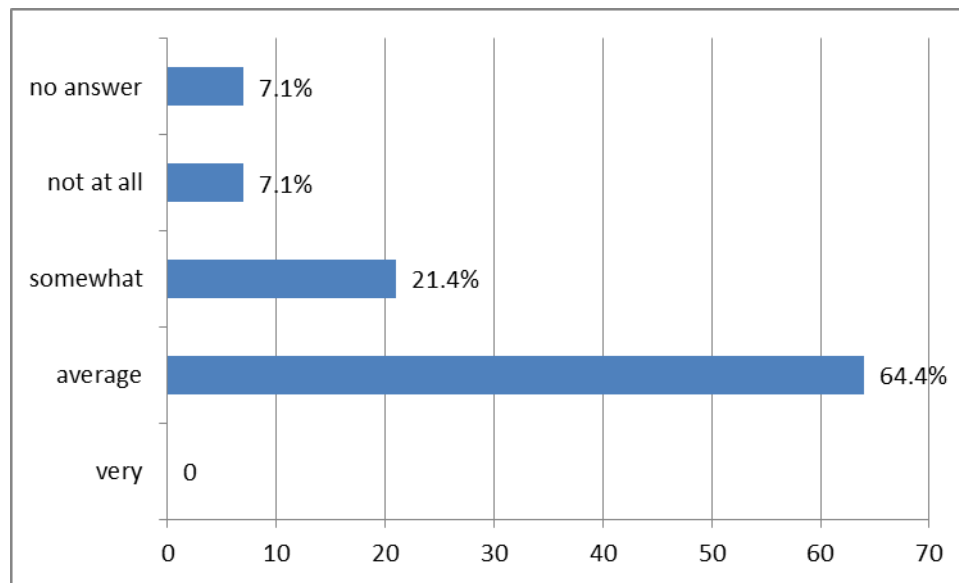
Did your clinical supervisor(s) specifically ask you to additionally screen patients for the presence/absence of serious medical pathologies?



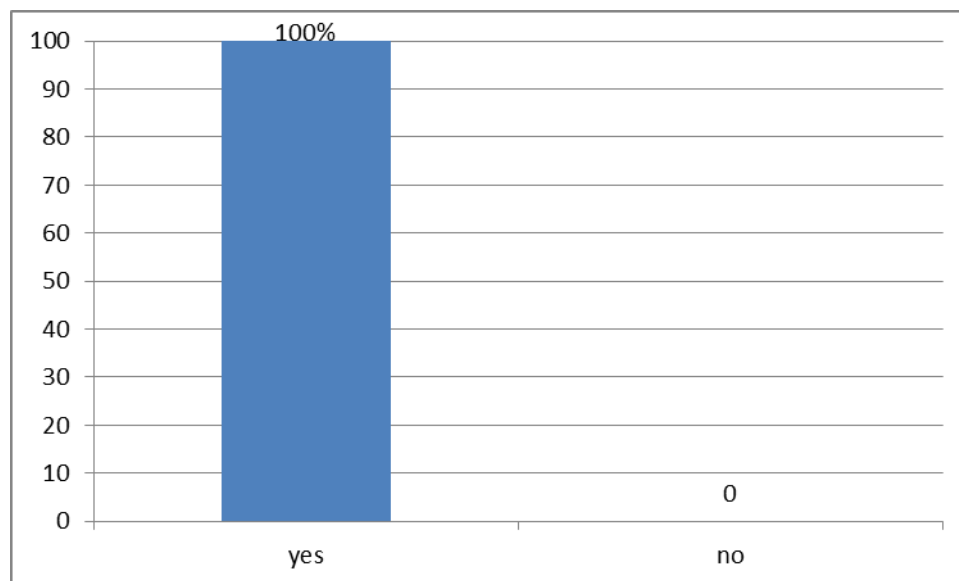
If you have answered the previous question with YES, were you asked to write the examination findings down?



How confident do you feel when you are asked to report your examination findings (in case you suspect a serious medical pathology) to the referring medical doctor?



Do you believe that keep/refer decision making abilities should be mandatorily taught (as an independent lecture) during the undergraduate physiotherapy education?

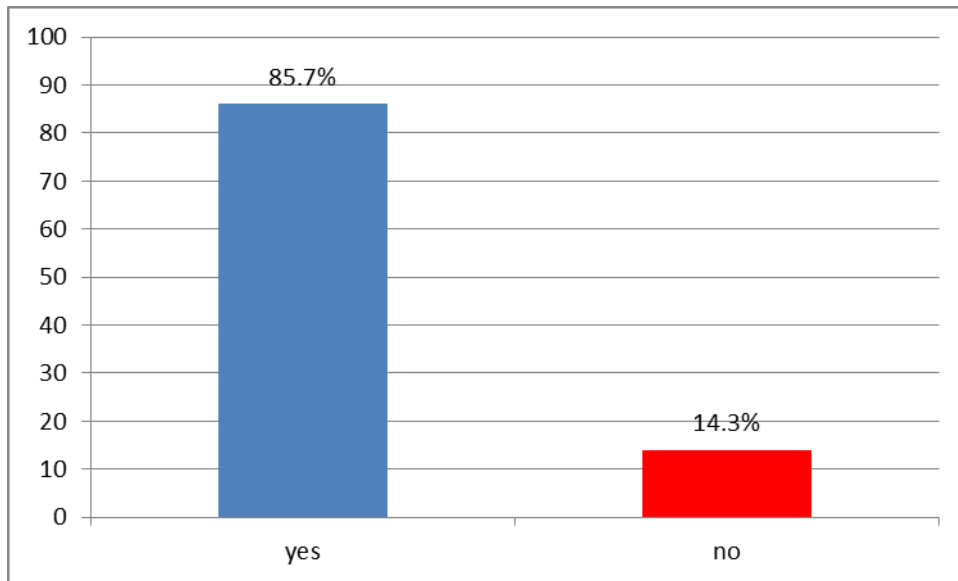


If you have answered the previous question with YES, which semester/year would you suggest?

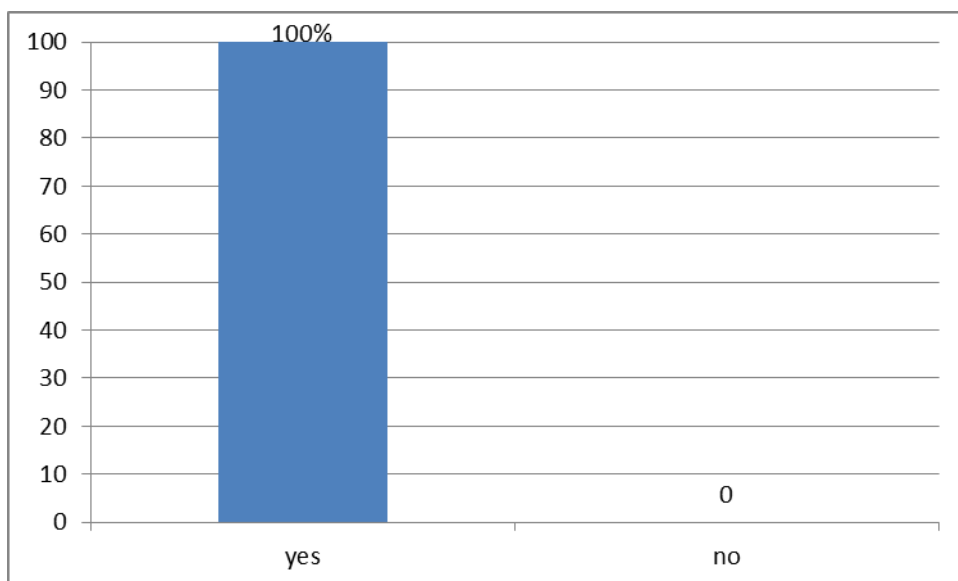
Semester 1	Semester 2	Semester 3	Semester 4	Semester 5	Semester 6
0	1x	5x	6x	4x	2x

Figure 5.3: Questions concerning the undergraduate education plus clinical placements.

Do you personally believe that screening patients for serious medical pathologies is an integral part of every physical examination?



Dou you believe that every qualified physiotherapist should be capable of screening patients for serious medical pathologies?



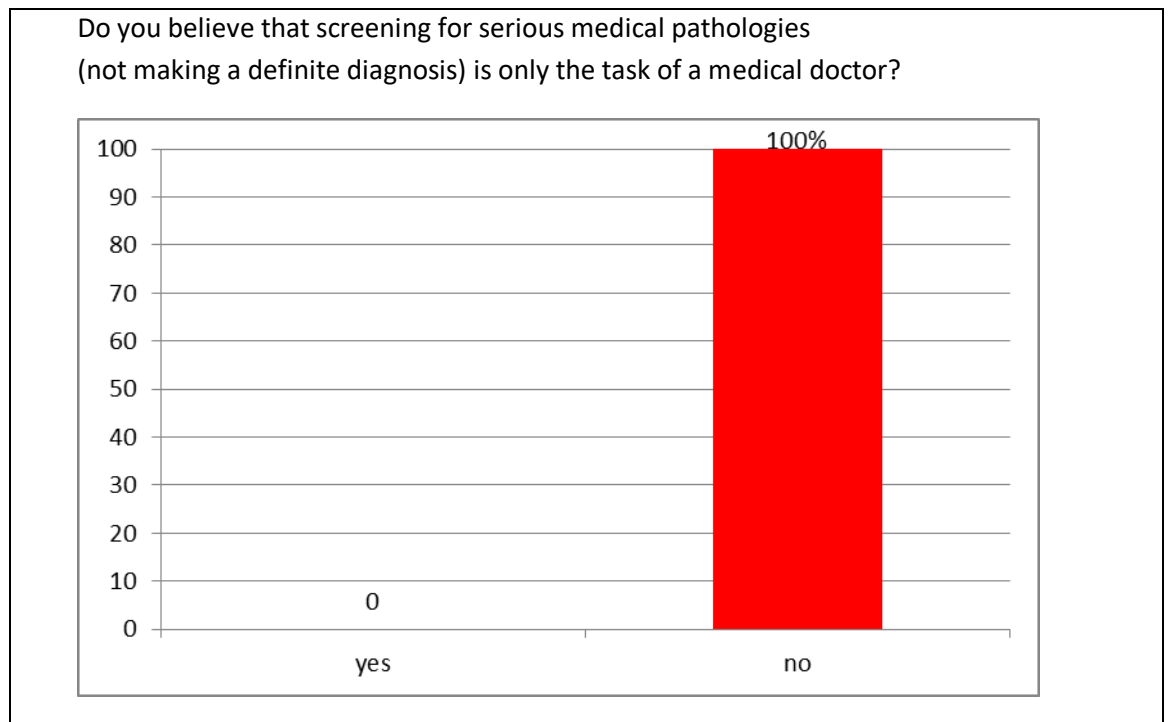


Figure 5.4: Questions concerning the physiotherapeutic profession in general.

5.4. Discussion

This is the first study to give an overview of final year undergraduate physiotherapy students from different European countries capabilities of making correct keep/refer decisions when being given concise, clinical vignettes. European undergraduate physiotherapy student participants made a correct keep/refer judgement for both the musculoskeletal and medical non-critical vignettes in more than 70%. Only slightly over 50% (on the average) of the medical critical cases were answered correctly.

This is consistent with earlier reports on qualified physiotherapists (Riddle et al., 2004; Jette et al., 2006; Beyerlein, 2010; Schämann et al., 2011; Mount, 2012) and DPT students (Vaughn et al., 2011) which also revealed a lack of knowledge to accurately detect severe pathological conditions. An alarmingly low number of eight European study participants (11%) managed to identify all three medical critical vignettes and correctly chose to refer the patient without giving any physiotherapy intervention. Childs et al. (2005) reported that physiotherapy students and qualified physiotherapists working in the United States Armed Forces possess a superb medical and (differential)

diagnostic level. However, they represent a rather distinct group within the physiotherapy profession due to highly specialised training.

It is beyond the scope of this thesis to make a detailed comparative analysis of teaching curricula across European countries and Universities. Results from the Netherlands and Estonia, however, demonstrate an apparent trend towards a higher proportion of students who are capable of making an accurate keep/refer decision for the medical critical cases (table 5.5). A recent review by Lackenbauer et al. (2017) (Appendix 31) revealed that the Dutch national guidelines for the physiotherapy profession very clearly demand their qualified physiotherapists to be capable of identifying pathologies which are not suitable for physiotherapy and therefore require a referral to another health care professional (e.g. a physician) (Lackenbauer et al., 2017). Unfortunately, no similar data exists for educational or professional guidelines from Estonia.

Results by Clark (2007) underlined that experienced physiotherapists in the United States regarded the recognition of serious medical conditions as a key component of their daily routine. This is in accordance with the outcome of the current study which clearly showed that final year undergraduate physiotherapy students in Austria considered the ability to identify sinister pathologies not only to be vital for medical doctors but also for physiotherapists. Interestingly, this overall positive attitude (100% in the present study) towards screening for serious pathologies somewhat contradicts earlier reports by Donato et al. (2004) which showed that physiotherapists working in a non-direct access system (as it is currently the case in Austria) put less emphasis on recognising serious medical conditions (Donato et al., 2004). The outcome of the current questionnaire also confirms earlier reports by Knipp (2008) which have demonstrated mixed responses towards Austrian physiotherapists' self-perceived confidence of being capable to recognise the presence of serious pathological process within their patients' clinical presentation (Knipp, 2008).

Students' performances from the diverging access systems to physiotherapy service demonstrate a clear tendency that students from a direct access system to physiotherapy for the private health sector were generally more accurate in the identification of the medical critical vignettes. Interestingly and also surprisingly, those differences were absent when comparing correct keep/refer decisions for medical

critical cases between students from countries with direct access for the public and private sector and those from countries without direct access to physiotherapy.

The low return rate of this study (3.3%) makes generalizability of the results problematic, even for ENPHE member Universities. Having said this, the overall low response rate (less than 5%) is still in accordance with Vaughn et al. (2011) who had a very similar methodology. As opposed to Riddle et al. (2004), Jette et al. (2006), Beyerlein (2010), Schämann et al. (2011) and Mount (2012), Vaughn et al. (2011) were not able to directly distribute their survey among their study sample (final year DPT students). As in the current study, Vaughn et al. (2011) had to rely on individual Universities to subsequently distribute the survey among the final year physiotherapy students.

When looking at the results of individual vignettes in the current project, it becomes obvious that some vignettes seemed to be more demanding than others.

Some of the vignettes which yielded generally poorer results are discussed below:

Vignette number two:

Vignette number two described the very typical clinical presentation of a stress fracture of the metatarsal bones (Bruckner and Khan, 2009; Kahanov et al., 2015). Yet, 73% of all participating students failed to recognize the need for, at least, additional medical examination. This relatively high percentage of students who failed to recognize a bony fracture of the mid foot (and therefore the need for, at least additional, investigation) is somewhat unexpected. Stress fractures of the metatarsal bones have a high prevalence; Only stress fractures of the tibia seem to be more common (Bruckner and Khan, 2009). It is therefore almost certain that the vast majority of physiotherapists will encounter a stress fracture of the metatarsal bones during their career. Furthermore, vignette number two described some very typical features of a stress fracture: The patient's pain started during running and increased whenever putting weight on the affected limb (Bruckner and Khan, 2009; Kahanov et al., 2015). There was also tenderness on palpation over the area of the fracture (Bruckner and Khan, 2009; Kahanov et al., 2015). With the exception of Germany, Lithuania and the Czech Republic, less than 35 percent of the students from the remaining countries correctly estimated the risk of a more

severe underlying injury (figure 5.5). In the special case of Lithuania, the one respondent chose the answer option keep/refer for all 12 vignettes and should therefore be neglected. Having said all this, the poor performance on vignette number two in the present study is still consistent with the results by Jette et al. (2006), Beyerlein (2010) Schämann et al. (2011) and Vaughn et al. (2011).

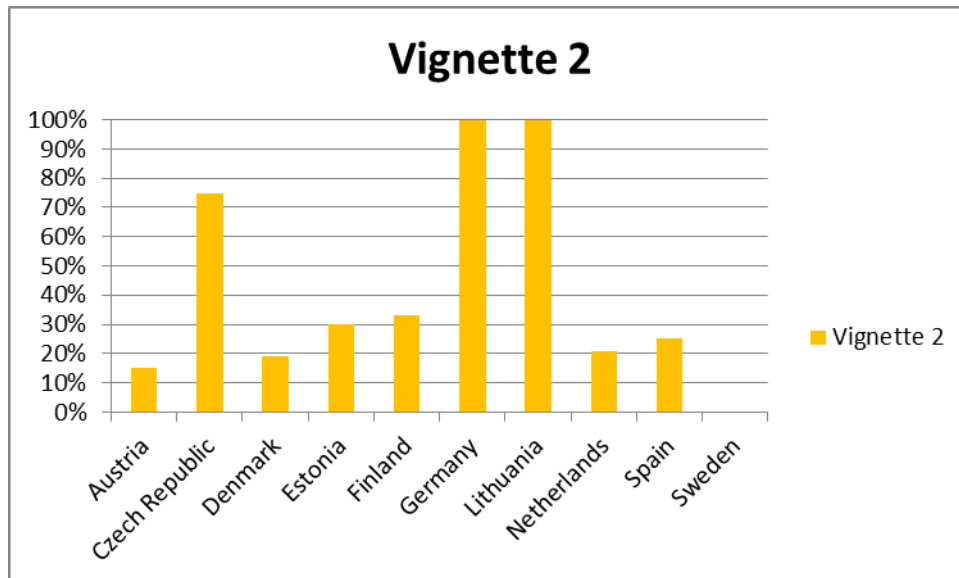


Figure 5.5: Percentage of students who made a correct keep/refer decision for vignette number two.

Vignette number five:

‘A hot, swollen joint without trauma: septic arthritis until proven otherwise’ (Oliviera et al. 2015:1). This phrase is perfectly applicable for vignette number five which portrays the medical emergency situation of a 60 year old patient with a suspected septic knee joint. 53% of the participants of the current study recognized the need for immediate medical referral without providing physiotherapy. Final year undergraduate physiotherapy students performed even better than qualified physiotherapists in Germany (Beyerlein, 2010) and in Switzerland (Schämann et al., 2011). But still, 7% (n=5) of the respondents within the current study did not see any reason for, at least, concurrent medical evaluation. This is slightly alarming as a septic joint needs to be viewed as an emergency situation with, when left untreated, detrimental effects for the patient’s health (Oliviera et al., 2015).

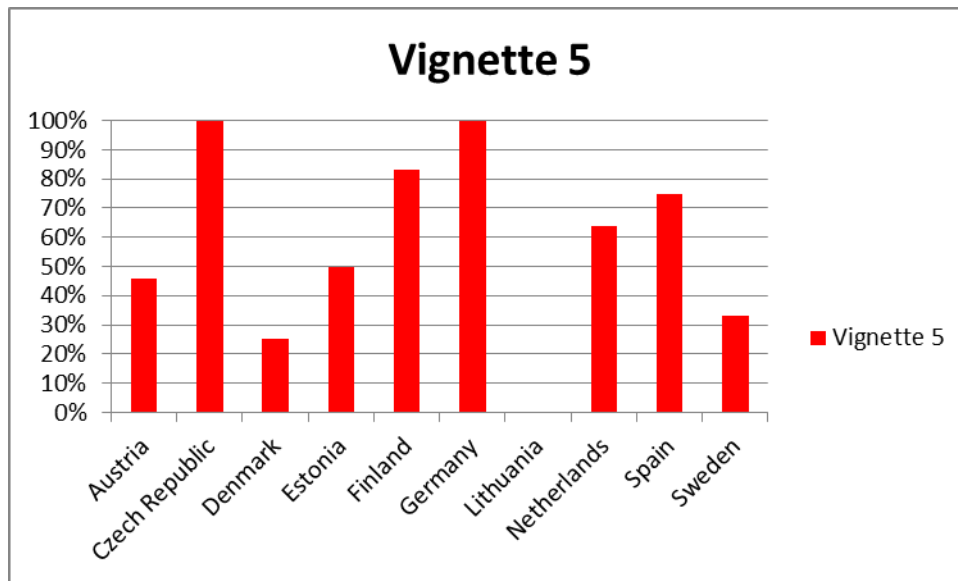


Figure 5.6: Percentage of correct keep/refer decisions for individual countries for vignette number five.

Vignette number eight:

Vignette number eight, on the other hand, contained no clinical feature which indicated major structural damage to the knee joint. This case described a young female who injured her knee during a softball game. The patient had full range of motion, no joint locking and only slight swelling and tenderness on the medial aspect of the knee. This case describes the classical picture of a medical collateral ligament (MCL) sprain. When applying the Ottawa knee rule [for more information on the Ottawa ankle rule, please refer to Appendix one, page 232 of this thesis] a fracture can be safely ruled out. The full range of motion and absence of joint locking most certainly excludes a major meniscal injury. Although not viewed as incorrect for the analysis, the vast majority of respondents (63%) chose concurrent medical check-up (keep/refer) to exclude possible more severe structural damage. 16% percent of the students even chose to refer the patient without any physiotherapy intervention (refer). Interestingly, two out of four medical doctors (the internal physician and family practitioner) who validated the vignettes in Vaughn et al. (2011) believed that this case requires medical check-up prior to any physiotherapy management. However, the other two medical experts (orthopaedic surgeon and emergency physician) deemed this case to be relatively

harmless and did not see a reason for medical investigation (at least not without additional conservative treatment).

This generally cautious approach to this vignette in the current study is not in accordance with recent treatment recommendations for isolated MCL injuries. A very recent review on treatment options (surgical versus conservative) for MCL injuries clearly recommends the conservative, non-surgical approach (Smyth and Koh, 2015). In addition, Chen et al. (2008) reported a recent tendency to a non operative treatment approach even in the situation of grade III and complete (isolated) ruptures of the MCL (Chen et al., 2008).

Vignette number nine:

For vignette number nine, the minority of study participants correctly recognized the need for prompt medical referral and investigation. This case describes a 70 year old patient with a major visceral pathology (possibly an abdominal aortic aneurysm) as underlying cause of the complaints. The expert panel of four medical doctors in Vaughn et al. (2011) unanimously agreed that this patient needed immediate referral. Assuming that this patient really had an AAA as underlying cause of his thoracolumbar complaints, not referring this patient for prompt medical investigation (and subsequent treatment) may have grave consequences for the patient.

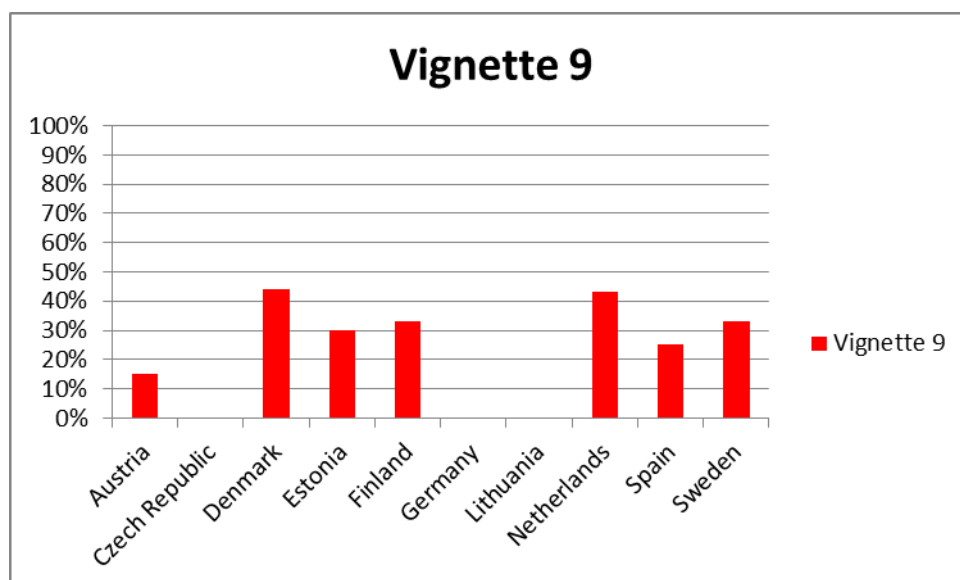


Figure 5.7: Percentage of correct keep/refer decisions for individual countries for vignette number nine.

Vignette number 10:

For vignette number ten, only about 20% of all study participants made a correct keep/refer decision. However, this meagre result is very similar to the outcome in earlier studies (Jette et al., 2006; Beyerlein, 2010; Schämann et al., 2011; Vaughn et al., 2011). This vignette describes a middle aged female patient with sudden onset of chest pain which can be altered by arm movements. In addition, there is pain on palpation of the structures of the costochondral junction. However, vignette number 10 has already raised some controversy about the supposedly correct keep/refer decision. While Jette et al. (2006) considered this case to be of musculoskeletal origin (typical clinical presentation of costochondritis), the emergency physician from the expert panel in Vaughn et al. (2011) argued that this case should be regarded as a medical critical case which definitely requires medical investigation prior to any physiotherapy intervention. To support his claim, the emergency physician cited Lee et al. (1985) who demonstrated that the aforementioned symptoms are not entirely uncommon in patients with chest pain of myocardial origin. As already indicated above, the one study participant from Lithuania always chose the answer option keep/refer and consequently lacks real significance for the results in general.

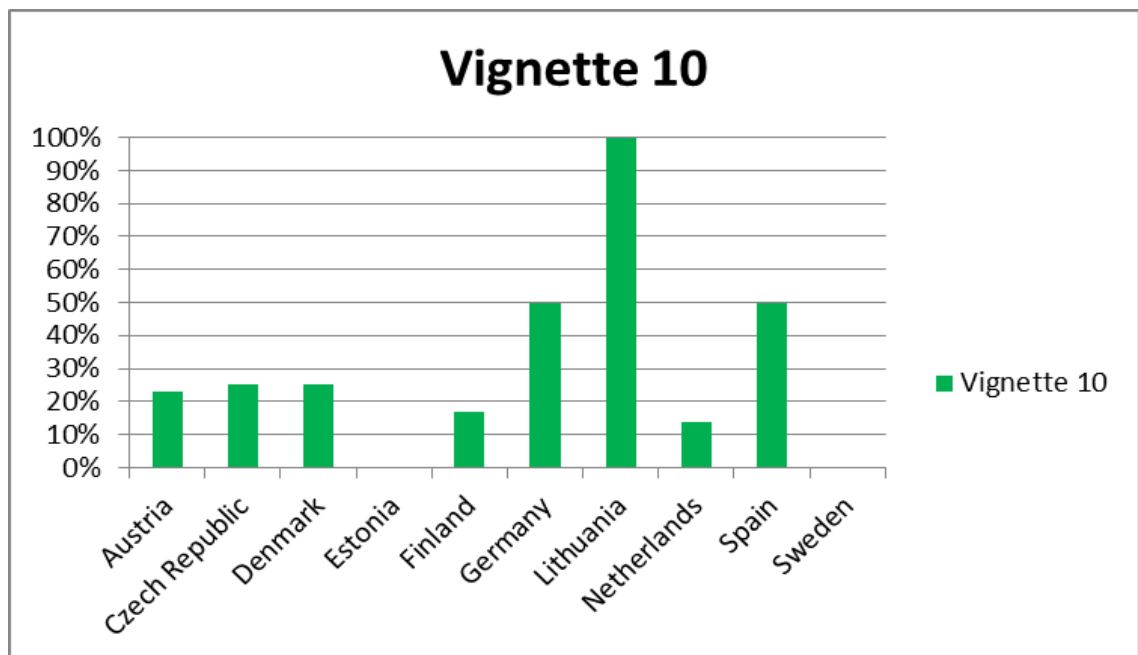


Figure 5.8: Percentage of students who made a correct keep/refer decision for vignette number 10.

In general, study participants from Austria did neither perform particularly bad nor exceptionally well. Having said this, only one Austrian student out of 13 made a correct decision (refer) for all three medical critical cases. This individual student is also responsible for a higher number for the mean percentage of correct keep/refer decisions within the medical critical category. With an average percentage of 46% of correct keep/refer decisions for medical critical vignettes, the performance of Austrian final year undergraduate physiotherapy students was similar, or only marginally inferior, to those from other countries such as Denmark (45%), Finland (55%), Germany (50%) and Spain (50%). However, median percentages of correct keep/refer decisions revealed that the majority of Austrian students only managed to make an accurate keep/refer decision for one (out of three) medical critical vignette. In contrast, the median and mean percentages of correct keep/refer decisions within the medical critical category of the other aforementioned countries (except for Denmark) remained fairly constant (table 5.5, page 104). This poor performance is worrisome but not entirely unexpected. While all respondents from Austria believed that physiotherapists should be able to recognize severe pathologies, the minority (36%) felt sufficiently trained to actually identify conditions which are not suitable for physiotherapy. This inadequacy of formal training in Austria is further highlighted by the fact that more than 70% of respondents denied of having read any specific literature about keep/refer decision and/or recognition of serious medical diseases as part of a lecture during their undergraduate time. This is especially problematic in light of current aspirations of the Austrian physiotherapy association to implement a direct access system to physiotherapy (Baumgartner, 2013; Bauer-Horvath, 2015; Sorge, 2017).

5.5. Limitations

Even though clinical vignettes are widely accepted as a valid tool to examine clinical decision making strategies of health professionals (Peabody et al., 2000; Peabody et al., 2004; Evans et al., 2015; Rousseau et al., 2015), there are some authors that criticised their general use within health care related research (Veloski et al., 2005; Mohan et al., 2014). Veloski et al. (2005), for instance, raised the concern that vignettes are not capable of simulating decisions which are made under time pressure. Having said this, for the most part of the current research, this issue was accounted for. Final year

undergraduate physiotherapy students were given a limit of 15 minutes to complete the 12 vignettes. 15 minutes is in line with Beyerlein (2010) who also asked his study participants to try to finish the 12 vignettes within 15 minutes. However, Beyerlein (2010) did not set a timer function and was therefore not able to check if the participants in his study really abided to the proposed time limit. In the current study, on the other hand, a timer function was set and students were forced to complete the vignettes within 15 minutes. Unfortunately, the online survey tool had to be changed during data collection. The initial survey tool Lime Survey which had been provided by the University of Applied Sciences in Krems experienced a major server breakdown and could not be accessed after July 2016. For the remaining data collection, the Bristol Online Survey Tool (BOS) which was provided by Manchester Metropolitan University was used. Unfortunately, BOS did not have a timer function and it was therefore not possible to simulate the pressure of time for the rest of the data collection.

In this context, Veloski et al. (2005) also mentioned social desirability bias. He argues that since study participants are usually quite aware of the fact of being under investigation, their response might represent a more idealistic decision which can substantially differ from what they would actually do during their daily routine. Even though this form of bias cannot be completely ruled out, the use of standardized patients (which is the gold standard) would have been infeasible for the current study, which involved undergraduate physiotherapy students in different European countries.

Another important point applies to the content validity of the 12 vignettes. The 12 vignettes have already been validated on two different occasions by expert physiotherapists (Jette et al., 2006) and a panel of medical doctors (Vaughn et al., 2011). Yet, not all vignettes could reach 100% consensus during the validation process (Vaughn et al., 2011). This issue became especially obvious in vignette number ten. While this case was originally thought to describe a rather benign musculoskeletal health problem (costochondritis) (Jette et al., 2006), the emergency physician in Vaughn et al. (2011) vehemently argued that the signs and symptoms described in vignette number 10 were also very typical for a myocardial infarct. Interestingly, the bulk of students in the current study also deemed this case to be highly suspicious and chose to refer the patient without giving any physiotherapy intervention (refer).

In addition, it was not possible to capture a complete European wide picture. First of all, the target population of final year undergraduate physiotherapy students was limited to students from ENPHE member Universities only. ENPHE member institutions do not represent all Universities within Europe which offer an undergraduate degree in physiotherapy. As a direct consequence, the results cannot be used to make a generalized statement about keep/refer decision making abilities of European undergraduate physiotherapy students. Secondly, it was not possible to convince all ENPHE Universities to participate in the current study. The low return rate (less than 5%) makes generalizability of the results even for ENPHE member Universities difficult. Having said this, the overall return rate in the current study is still in accordance with Vaughn et al. (2011) who used a similar approach to examine keep/refer decision making abilities of final year DPT students in the United States.

Another important issue applies to non-response bias. First of all, it is quite likely that only those students completed the survey who felt comfortable of making an accurate keep/refer decision based on clinical vignettes. Secondly, it can be hypothesized that some students had doubts about their ability to complete a survey which was entirely in English. Although students studying at ENPHE member institutions are supposed to be used to take part in European research projects which are usually completely in English, one ENPHE contact person even explicitly stated that his students will not be enthused by the prospect of taking part in a study which is not in their native language (Appendix 15).

In addition, it is unclear if students really completed the survey alone. Students were explicitly asked to finish the survey on an individual basis but there is no way of telling if they complied with this request. In this context, the situation with the respondents from the Czech Republic needs to be brought up. In four out of 12 cases, students from the Czech Republic gave identical answers. Above all, responses for two out of three medical critical cases were exactly the same and almost identical for the third medical critical vignette (Appendix 16). This might of course be completely coincidental and attributable to the small number of study participants ($n=4$) from the Czech Republic. Having said this, a certain degree of suspicion persists and the results from the Czech Republic should only be regarded with caution.

Moreover, it is unknown if any students were familiar with the vignettes which were taken (with permission) from an already published and open access research paper by Jette et al. (2006). In contrast to Beyerlein (2010), Vaughn et al. (2011) and Childs et al. (2005) who also used previously published material for their studies, the original source of the 12 vignettes which were used for the current project was not indicated. Even though students could neither print out nor save the survey to complete it later, students were deliberately not asked if they already knew the vignettes from Jette et al. (2006). The reason for this was that students should be prevented from looking up the original article by Jette et al. (2006). In Vaughn et al. (2011) and Childs et al. (2005), study participants were specifically asked (by stating the references) if they had any knowledge about the material being used. If this was affirmed, participation in their research was not possible anymore (Childs et al., 2005; Vaughn et al., 2011). A different approach for the current study was used for the following reason: Even if students might have already read the study by Jette et al. (2006) and were therefore familiar with the vignettes, it was considered rather likely that those students had probably forgotten the correct answers for individual vignettes. It is even conceivable that some students might have, upon completion of the survey, the feeling that they had already seen those vignettes but could not definitely say where they read them. By indicating the exact reference, however, finding them online would have been relatively easy.

The last limitation concerns the possibility of making a correct keep/refer decision by chance. Two different answer options for the vignettes of the musculoskeletal (keep or keep/refer) and medical non critical category (keep/refer or refer) were considered correct. Conversely, there was no alternative other than referring the patient without any physiotherapy intervention (refer) for the three medical critical cases. This alone might explain the generally poorer results within the medical critical category (table 5.2-5.6, page 101). While this is acknowledged, the possibility of coming across potential medical emergencies justifies a rather rigorous approach without any other options for the treating physiotherapist.

5.6. Conclusion

This study provides a preliminary and cautious overview of keep/refer decision making competencies of final year undergraduate physiotherapy students from ten different European countries (including Austria). In addition, this study gives valuable insight into the attitude and perception of final year Austrian undergraduate physiotherapy students towards keep/refer decision making as part of their profession and undergraduate education. The results showed a generally positive attitude of Austrian final year undergraduate students towards keep/refer decision making and screening for serious conditions as part of the education and profession. Final year undergraduate physiotherapy students in Austria also believed that keep/refer decision making abilities should be taught as an independent lecture during the undergraduate education.

Novice physiotherapists cannot be expected to achieve equal accuracy as experienced physiotherapists and DPT students when making keep/refer decisions. It was therefore not an objective to compare the results of the current study with findings from previous research which had been done on qualified physiotherapists in the United States (Jette et al., 2006), Switzerland (Schämann et al., 2011), in Germany (Beyerlein, 2006) and on DPT students in the United States (Vaughn et al., 2011). Novice physiotherapists, however, also work with patients without supervision and, depending on the health care system, even without prior medical referral and are therefore continuously challenged to independently determine if a patient is suitable for physiotherapy as part of a professional and/or ethical obligation. Hence, it is interesting to see the results of this study in the context of other studies that have used the same vignettes (table 5.7).

Table 5.7: Results of current study compared to previous research which used the same vignettes.

	Musculoskeletal	Medical non critical	Medical critical
Results for Austrian physiotherapy students	77%	73%	46%
Results for European physiotherapy students	75%	72%	52%
Jette et al. (2006) US qualified physiotherapists	87%	88%	79%
Beyerlein (2010) German qualified physiotherapists	78%	88%	53%
Schämann et al. (2011) Swiss qualified physios	76%	81%	67%
Vaughn et al. (2011) US DPT students	78%	79%	68%

Although the response rate of the current study was very low and therefore generalizability of the results is definitely problematic, outcome data of the current project gives the clear impression that, in general, European final year undergraduate physiotherapy students (including those from Austria) are not sufficiently equipped with enough knowledge and skills to make very precise keep/refer decisions based on clinical vignettes and, most importantly, seem insufficiently trained to accurately identify more severe medical conditions which require a timely referral to another health care professional (e.g. a physician).

5.7. Summary of chapter 5

- European final year undergraduate physiotherapy students made on average a correct keep/refer decision in slightly more 50% of vignettes from the medical critical category.
- Austrian final year undergraduate physiotherapy students made on average a correct keep/refer decision in less than 50% of vignettes from the medical critical category.
- Screening for serious pathologies is neither emphasized during the Austrian undergraduate physiotherapy degree nor by all supervisors during clinical placements in Austria.
- Austrian final year undergraduate physiotherapy students, however, deem the ability to independently identify more serious conditions to be highly relevant for their clinical work.
- Austrian final year undergraduate physiotherapy students believe that making independent keep/refer decisions should be mandatorily taught (as independent lectures) during the undergraduate degree.

Chapter Six

A cross sectional survey to explore the importance of keep/refer decision making within physiotherapy education and the profession from the perspective of medical doctors in Austria

6.1. Introduction

Chapter five provided a baseline of the current keep/refer decision making competencies of Austrian final year undergraduate physiotherapy students within Europe. The results of chapter five demonstrated weaknesses of European final year undergraduate physiotherapy students (including those from Austria) to accurately recognise serious pathologies based on clinical vignettes. The outcome of an additional questionnaire showed a generally positive attitude of Austrian final year undergraduate students towards inclusion of screening for serious conditions as part of the undergraduate education and professional practice. Final year undergraduate physiotherapy students in Austria also believed that keep/refer decision making abilities should be taught as an independent lecture during the undergraduate education.

So far, little is known about the significance of physiotherapists being able to make autonomous keep/refer decisions and to screen patients for the presence of serious medical conditions from the perspective of medical doctors in Austria. In addition, no study so far has evaluated which clinical examination procedures from the perspective of medical doctors every qualified physiotherapist should be capable of and need therefore be included in the undergraduate curriculum.

The reasons for surveying Austrian medical doctors as part of this thesis were as follows:

- Medical doctors are important stakeholders within the broad discussion about increased professional autonomy for physiotherapists in Austria.
- Patients in Austria require prior medical evaluation and referral before they can access physiotherapy service. It is therefore considered critical to observe the opinion of Austrian physicians towards Austrian physiotherapists (start) carrying out activities (i.e. making independent decisions about the suitability of physiotherapy intervention and

screening for the presence of serious pathologies) which were traditionally the tasks of medical doctors in Austria.

Chapter six addresses objectives IV and V of this thesis:

- IV. Using web-based-surveys (quantitative data) to get insight into the opinion and attitude of Austrian medical doctors towards independent keep/refer decisions and the recognition of serious pathologies as part of the physiotherapy education and profession in Austria.
- V. Using web-based surveys (quantitative data) to get insight into the opinion of Austrian medical doctors which clinical examination procedures Austrian physiotherapy students and qualified physiotherapists should be capable of.

In order to address these two objectives, this study used a descriptive survey (in a web-based, electronic format) among general practitioners and orthopaedic surgeons working in private practice in Austria.

The methodology, results and discussion sections adhere to the Survey Reporting Guideline (SURGE) (Grimshaw, 2014).

[Chapter six has been published in the peer-reviewed journal Physioscience. The abstract is attached as Appendix 33 on page 318 of this thesis. The original publication is available online using the following link: DOI: 10.1055/a-0833-1759]

6.2. Methods

6.2.1. Research tool

Due to the lack of availability of appropriate survey instruments, the questionnaire was developed as a bespoke instrument for this PhD. The initial ideas of which topics should be covered and which questions needed to be included were taken from one journal article by Donato et al. (2004) and a doctoral thesis by Clark (2007). The first draft of the questionnaire was then sent to the supervisory team for feedback (Appendix 17). After two feedback rounds, the final version of the questionnaire consisted of 10 questions divided into three categories:

- General questions (n=1).
- Questions concerning the physiotherapy under-and postgraduate education in Austria (n=5).
- Questions regarding (the doctors') everyday work (n=4). (Appendix 18).

The first section (general questions) was included to observe the practice patterns of responding physicians i.e. number of referrals to physiotherapy. In addition this question was also useful to detect possible non-response bias if only physicians responded who made more than 100 referrals each year.

The purpose of the second section (questions concerning physiotherapy education) was to gain insight into the opinion and attitude of medical doctors towards Austrian physiotherapists making independent keep/refer decisions and screen patients for the presence of serious pathologies. In addition, medical doctors were given the opportunity to recommend different examination procedures (from a pre-specified list which was developed during the pilot phase with feedback from Austrian medical doctors) which they deemed relevant for physiotherapy education and professional practice.

The last section aimed at getting insight into the current level of collaboration (from the medical doctors' perspective) between physicians and physiotherapists in Austria. Moreover, responding physicians could give examples of incidences where physiotherapists have failed to recognize the presence of serious medical conditions.

While the utilization of a specific scale (e.g. a Likert Scale) for survey related research has the major advantage of obtaining a summary score (Portney and Watkins, 2009), the decision was made to refrain from using a scale for the following reasons: Firstly, a scale consists of several questions (ideally 10-20) which are structured around one singular characteristic of interest (Portney and Watkins, 2009). As the current survey consisted of three different categories, the application of a scale would have resulted in a considerably longer research tool. McFarlane et al. (2007) highlighted the fact that physicians are more likely to complete a concise survey.

Secondly, the vast majority of questions could be answered with a simple yes or no. Only two questions offered four multiple-choice-options. As previously described, the development of a scale requires a great quantity of questions with both favourable and unfavourable attitudes (Portney and Watkins, 2009).

6.2.2. Pilot testing

It is recommended that a survey should undergo pilot testing on a manageable number of individuals (which are representative of the target population) before being used for research purposes (Portney and Watkins, 2009). The rationale for this is to assess the comprehensibility of individual questions and to measure the time required to complete the survey (Portney and Watkins, 2009). A German translation of the questionnaire was therefore sent (via e-mail) to three medical doctors in Salzburg/Austria.

The pilot testing for the current survey was performed on two different occasions: During the first round, volunteering medical doctors commented on their general understanding of the questionnaire and the appropriateness as well as proper sequencing of individual questions. In addition, the volunteering medical doctors were specifically asked to add any examination items they deemed important for physiotherapists (or remove if deemed irrelevant). The (amended) final version of the questionnaire (Appendix 19) was then resent to the three medical doctors to give feedback about the time required to complete the survey instrument.

6.2.3. Sample selection

The majority of Austrian physiotherapists treat patients with complaints arising from the musculoskeletal system (Knipp, 2008) and most referrals to physiotherapy come from general practitioners and orthopaedic surgeons (Physio Austria, 2004). Hence, the population from which the samples were drawn consisted of general practitioners (n=6544) and orthopaedic surgeons (n=856) working in private practice in Austria. Through an extensive search for valid e-mail addresses on the official webpages of the Austrian Medical Council, an accessible population of 1886 general practitioners and 395 orthopaedic surgeons working in a private setting in Austria could be obtained. The

final sampling frames consisted of a random sample (obtained through simple random sampling) of 1000 general practitioners and all 395 orthopaedic surgeons working in private practice in Austria.

6.2.4. Survey administration

Survey distribution and data collection took place between October and November 2017. No financial incentives or other forms of compensation were offered. On October the 9th, an invitation e-mail containing full study description (Appendix 20) and a link to the actual survey was distributed. Four additional reminder e-mails to those who had not yet completed the survey were sent after two weeks had elapsed. The four reminder e-mails were sent over another period of 2 weeks. The rationale behind this was that, even though, the bulk of responses can be expected within the first two weeks after the initial survey distribution, additional reminders are powerful tools to maximise the return rate (Kanuk and Berenson, 1975; Portney and Watkins, 2009).

6.2.5. Ethical statement

The complete survey was online and password protected using the online survey tool Bristol Online Survey Tool (BOS).

All prospective participants were explicitly informed that unique identifier codes, which consisted of numbers (and/or letters), would be automatically generated for each subject by the online survey tool (Bristol online survey tool). These codes to identify individual responders were attached as a hidden question (not visible to participants) at the end of the questionnaire. This allowed Bristol online survey tool of tracking which subjects completed the survey and ensured that reminder mails were only sent to those who had not already completed the survey. These codes were immediately and permanently deleted once a survey had been received by the researcher. This was possible by choosing an advanced option from Bristol online survey tool. Within the drop down menu, a hidden question could be located and subsequently removed before the data was analysed. Deletion of these codes made it impossible to trace back a questionnaire to individual respondents. The deletion process was irreversible. It was also pointed out that participation was completely voluntary and participants had the right to refuse to participate and withdraw without any consequences and without the

need to give any reason. Withdrawal from the study was possible before and after the completion of the questionnaire. However, once the questionnaire had been returned, withdrawal was not possible anymore.

Ethical approval for this study was obtained from the Manchester Metropolitan University Ethics Committee 1390 (Faculty of Health, Psychology and Social Care) (Appendix 2) and from the University of Central Lancashire Ethics Committee STEMH 435 (School of Health Sciences) (Appendix 3).

6.3. Analysis

The return rates and the results of the responses of general practitioners and orthopaedic surgeons were summarized using descriptive statistics. Frequencies of responses were presented in percentages in relation to the total sample sizes (Portney and Watkins, 2009).

All questions (except for two, which were pure follow-up questions in case the previous question was affirmed) were mandatory. This ensured that only completed surveys were returned to the Bristol Online Survey Tool. Handling individual item missing data was therefore not an issue.

It was not an objective of the current study to investigate the effect of various demographic characteristics (e.g. age, gender, rural versus urban region) on the respondents' attitudes towards physiotherapists making independent keep/refer decisions. Consequently, an analysis of non-response error was not performed.

While acknowledging the fact that a wide range of different definitions on how to calculate the response rate exist (AAPOR, 2016), the return rates for the current study were calculated using the following formula:

$$\frac{\text{Number of responses to the survey (study sample)}}{\text{Number of potential participants (sampling frame)}} \times 100$$

6.4. Results

6.4.1. Demographic characteristics/General questions.

Of the 1000 general practitioners, who received the initial invitation and four additional reminder mails, 7.6% (n=76) took part in the study and completed the survey. Of the 395 orthopaedic surgeons who were sent the survey (initial invitation mail plus four reminder mails), 10% (n=40) returned a completed questionnaire.

As seen in figure 6.1, more than 60% (n=49) of general practitioners within the current study made more than 50 referrals to physiotherapy each year. Almost 90% of participating orthopaedic surgeons made more than 100 referrals to physiotherapeutic service each year (figure 6.1).

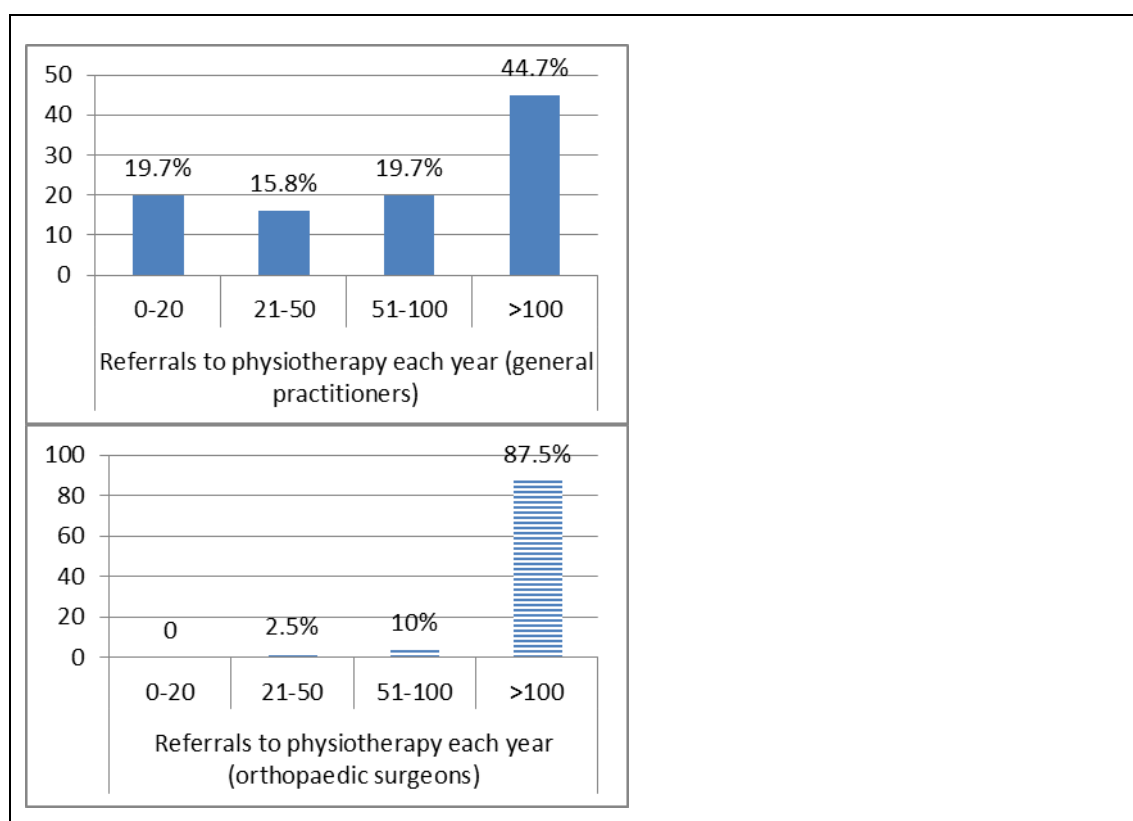
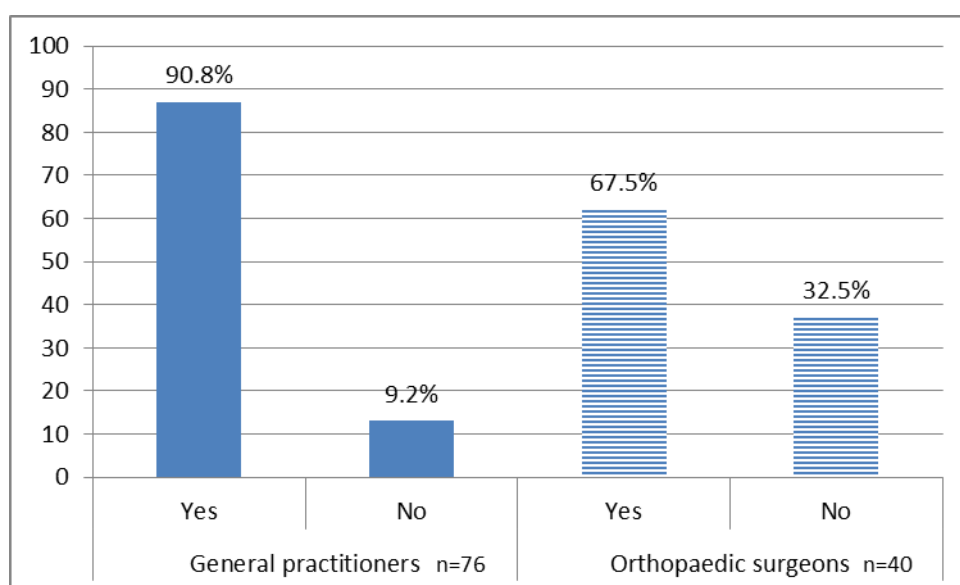


Figure 6.1: Demographic characteristics of participating general practitioners (n=76) and orthopaedic surgeons (n=40).

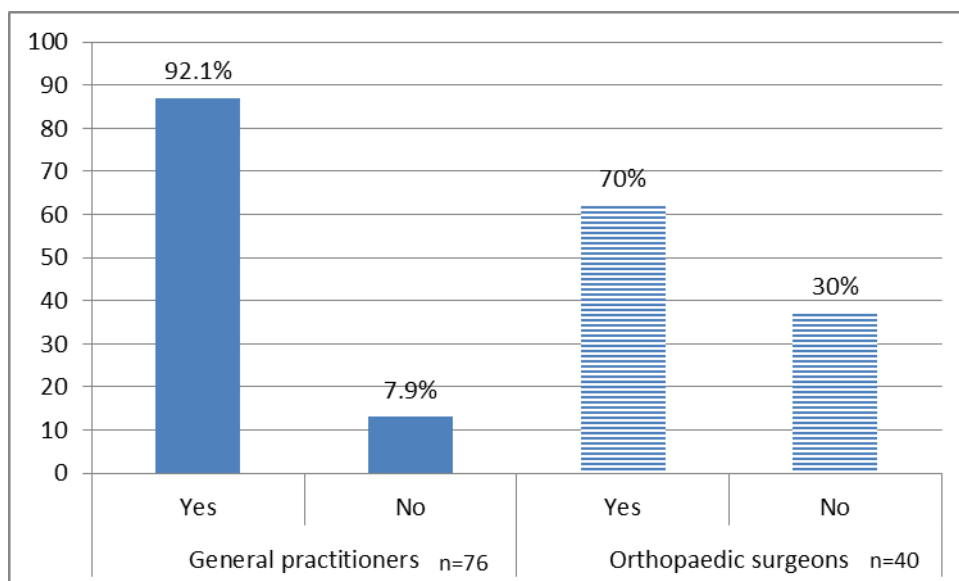
6.4.2. Keep/refer decision making competencies and screening for serious pathologies as part of the physiotherapists' undergraduate and postgraduate education.

As presented in figure 6.2, the vast majority of general practitioners within the current study sample are convinced that making precise and independent keep/refer judgements are highly relevant for the Austrian physiotherapeutic profession (90.8%) and should be a core component of the undergraduate (92.1%) and postgraduate education (86.8%). In addition, more than half of responding general practitioners (53.9%) find it highly relevant that physiotherapists screen patients for the presence of serious medical conditions, which require (additional) medical attention. Although the bulk of responding orthopaedic surgeons (67.5%) are still convinced that qualified physiotherapists in Austria need to make autonomous keep/refer decisions and that this should part of an undergraduate and postgraduate curriculum (70% and 62.5%, respectively), these numbers were smaller than for general practitioners within the current study sample. Moreover, only one third (32.5%) of orthopaedic surgeons found it very important that physiotherapists perform screening procedures to identify/exclude severe pathological processes (figure 6.2).

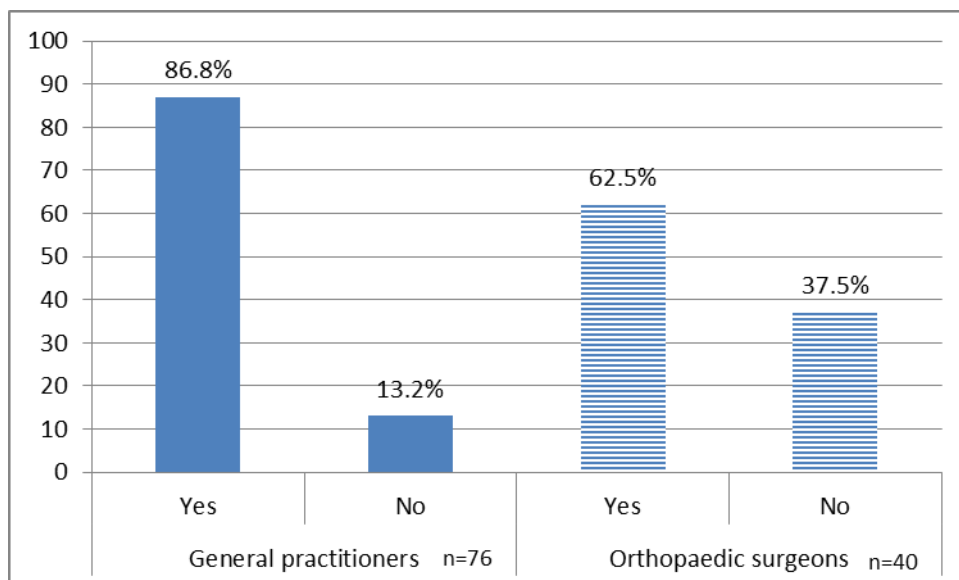
Do you personally believe that every qualified physiotherapist should be capable of making a correct keep/refer decision?



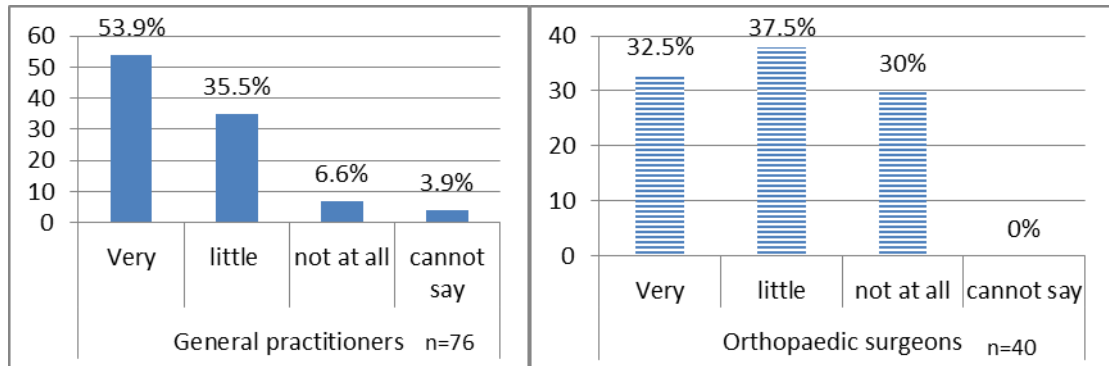
Do you personally believe that keep/refer decision making abilities should be an integral part of the physiotherapeutic undergraduate education in Austria?



Do you personally believe that keep/refer decision making abilities should taught during mandatory postgraduate courses?



How important do you think is that physiotherapists screen patients (in conjunction with the doctor's examination) for signs and symptoms of possible serious medical pathologies as part of their routine physical assessment?



Which of the following examination techniques should every qualified physiotherapist be capable of? (Multiple answers possible)

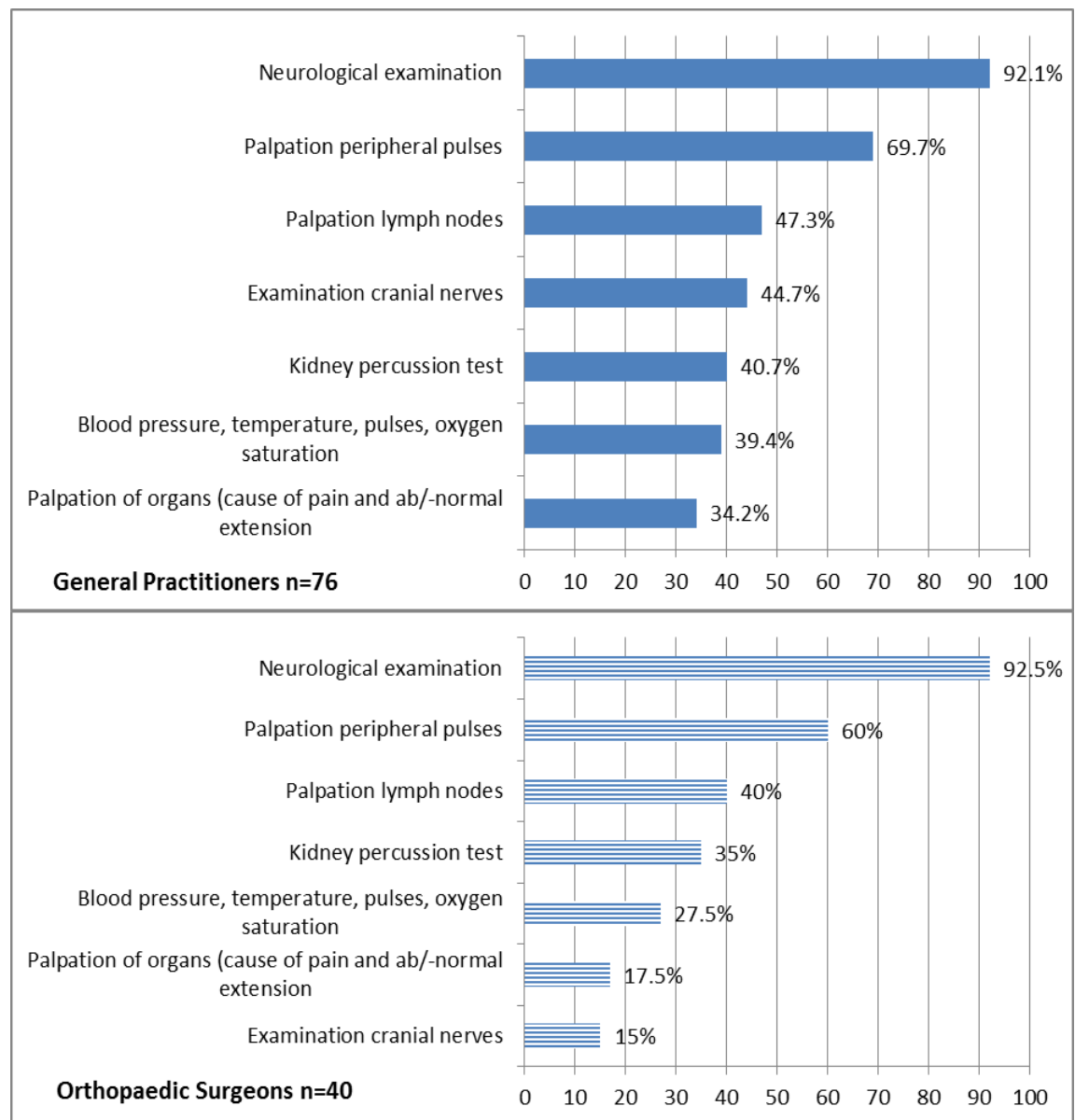
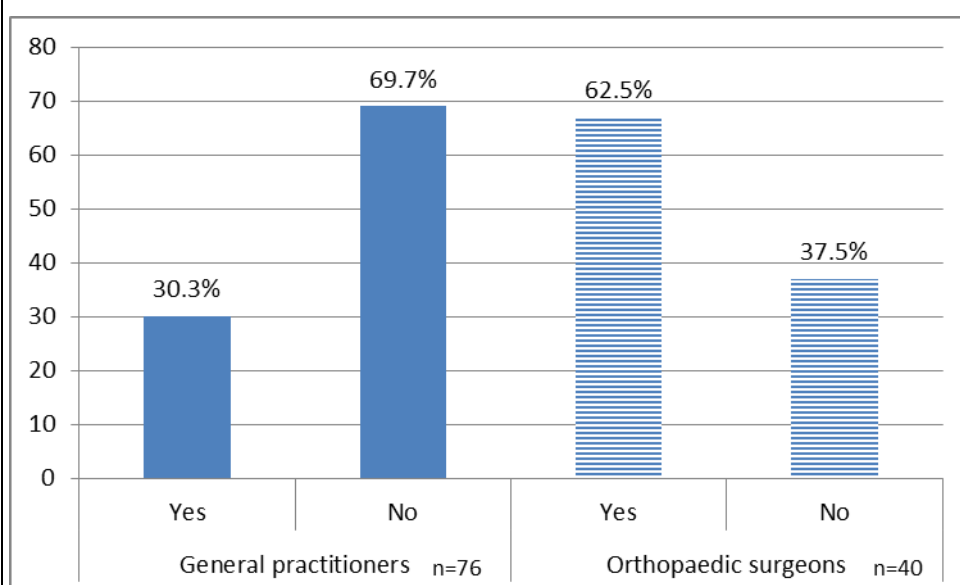


Figure 6.2: Questions concerning the physiotherapy under-and postgraduate education in Austria from the perspective of participating general practitioners (n=76) and orthopaedic surgeons (n=40).

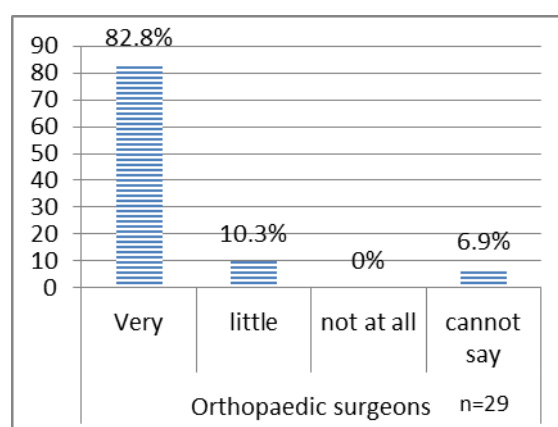
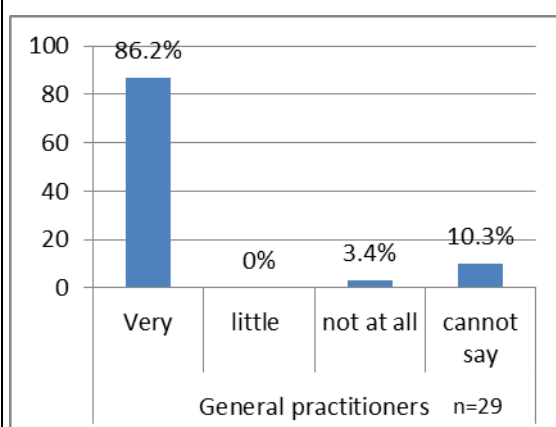
6.4.3. Interdisciplinary cooperation between physiotherapists and physicians.

As summarized in figure 6.3, more than 80% of responding general practitioners and orthopaedic surgeons deemed the feedback by physiotherapists due to worrying or even alarming peculiarities/changes in their patients' health status to be highly relevant for their further clinical decision making processes. Some responders also reported incidences where physiotherapists missed sinister pathologies.

Do physiotherapists (on a regular basis) contact you because of worrying or even alarming peculiarities/changes in their patients' health status?



If the answer is YES, how important is this sort of feedback for your own clinical decision making process?



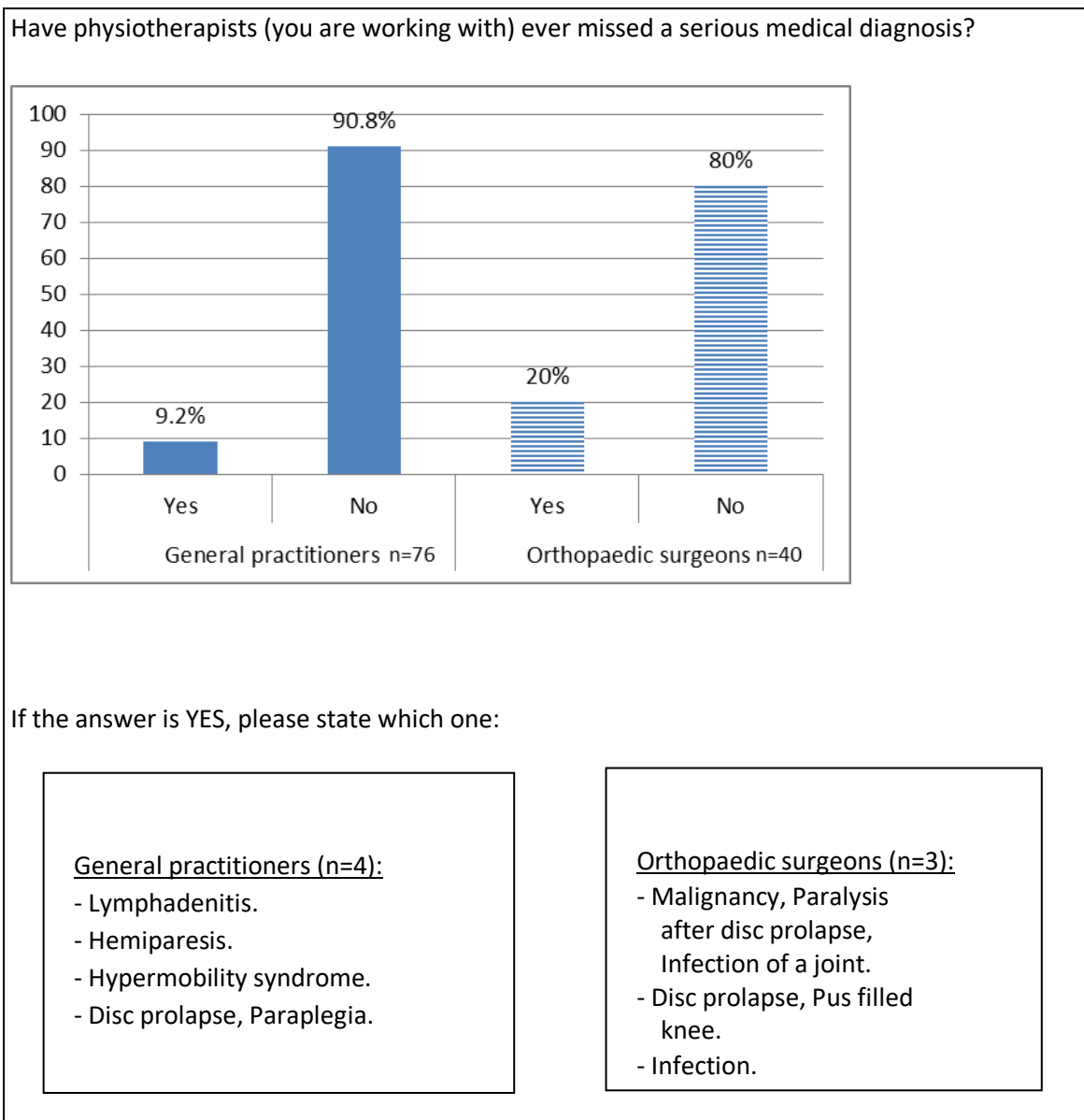


Figure 6.3: Questions regarding the general practitioners' and orthopaedic surgeons' everyday work.

6.5. Discussion

This is the first study to give an insight whether physiotherapists are considered capable of making independent keep/refer judgements from the perspective of medical doctors in Austria. Medical doctors are important stakeholders within the broad discussion about increased professional autonomy for physiotherapists in Austria. The results of the current study show that general practitioners and orthopaedic surgeons working in private practice in Austria predominantly believe that Austrian physiotherapists need to

be capable of making autonomous decisions if movement-based, physiotherapy management is indicated, or not. In addition, the bulk of study participants share the opinion that making such clinical keep/refer decisions should be taught both during the undergraduate time and as part of mandatory postgraduate courses.

This overwhelmingly positive attitude of responders towards physiotherapists making autonomous keep/refer judgements is in line with results from previous studies which focused on the perspective of qualified physiotherapists in the United States (Donato et al., 2004; Clark, 2007) and final year undergraduate physiotherapy students in Austria (chapter five, figure 5.4, page 113 of this thesis).

Slightly more than half of general practitioners within the current study sample (54%) found it very important that physiotherapists utilize screening procedures to exclude/detect more serious medical diseases as underlying reason(s) for the patients' pain disorders. Only 33% of responding orthopaedic surgeons regarded screening for sinister underlying conditions to be highly relevant for the physiotherapeutic assessment. 30% of participating orthopaedic surgeons concluded that screening procedures used by physiotherapists (to exclude/detect severe pathologies) were completely unnecessary. One orthopaedic surgeon within the current study even explicitly stated that the recognition/exclusion of dangerous pathologies is not the task of a physiotherapist at all. This generally less approving demeanour of responding physicians contradicted the viewpoint of Austrian final year undergraduate physiotherapy students who were unanimously convinced that screening for the presence of serious medical conditions was highly relevant for physiotherapists (chapter five, figure 5.4, pages 114 of this thesis).

The slightly divergent attitudes between general practitioners and orthopaedic surgeons regarding the significance of physiotherapists being able to conduct screening procedures which help to exclude/detect serious pathologies might be explained by the highly specialized training and advanced education of orthopaedic surgeons when handling and diagnosing conditions of the musculoskeletal system and severe pathologies affecting it. Hence, orthopaedic surgeons are probably more confident not to miss serious conditions which should not be referred to movement-based, physiotherapy management in the first place. General practitioners, on the other hand,

need to have a broader area of knowledge of other medical specialities but lack this in-depth expertise acquired by orthopaedic surgeons during their extensive training and daily routine with patients who suffer from ailments of the musculoskeletal system.

Although by far not all responders found screening for severe pathologies to be a central element of the physiotherapy assessment, four responding general practitioners and three orthopaedic surgeons reported a few instances where physiotherapists had overlooked the presence of serious medical conditions. This is particularly interesting as under the current regulatory framework in Austria, all the patients had been referred to physiotherapy by a physician in the first place, which therefore means the serious pathology had also been previously overlooked by a medical practitioner. As two different medical practitioners from different backgrounds and at different time points have both missed the serious pathology, this reinforces just how difficult identifying serious pathology and making appropriate keep/refer decisions are (figure 6.3). In spite of the fact that serious pathologies affecting the musculoskeletal system are reported to be rare (Henschke et al., 2009; Enthoven et al., 2016; de Schepper et al., 2016; Premkumar et al., 2018; Reito et al., 2018; Galliker et al., 2019), the results of this survey demonstrate again that physiotherapists, even in a non-direct access system with prior medical evaluation, do encounter conditions which are not appropriate for physiotherapy. Therefore appropriate training in this area is vitally important.

While the majority of responding orthopaedic surgeons (68%) deemed the physiotherapists' ability to make independent keep/refer decisions to be highly relevant, only a minority (33%) regarded screening for sinister medical diseases to be a very important facet of the physiotherapeutic assessment. Interesting, but at the same time slightly unexpected because making autonomous keep/refer judgements and screening for serious conditions are fundamentally interrelated with each other. On the other hand, current guidelines for physiotherapy profession and education in Austria do not contain any passages that categorically demand that physiotherapists recognize the presence of serious conditions (Physio Austria, 2004; MTD-FH, 2006). Only one official document, which describes the (possible) future role of the physiotherapy profession in a primary health care system (Physio Austria, 2014), mentions the necessity of Austrian physiotherapists to be able to decide whether movement based interventions are

indicated [for more detailed information, please refer to chapter one, section 1.8., page 31 of this thesis]. As a direct consequence, the one orthopaedic surgeon was right that, from a political and official point of view, recognizing the presence of underlying dangerous pathologies is (currently) not the task or duty of a qualified physiotherapist in Austria. While this is true from the current political point of view, official guidelines by the WCPT (WCPT, 2011) clearly demand from all physiotherapists that they know exactly when a patient's presentation requires referral to a physician. In addition, Goodman and Snyder (2013) and Boissonnault and Ross (2012) have already highlighted why every physiotherapist should be capable of making accurate keep/refer decisions. Above all, a recently released document by the professional physiotherapy association in Austria (Eckler et al., 2017) requires undergraduate physiotherapy students (in the case of direct access) to learn how to make accurate keep/refer decisions and screen patients for the presence of serious pathologies which are not suitable for physiotherapy interventions [for more detailed information, please refer to chapter one, section 1.8., page 31].

While not all respondents found screening for the presence of serious medical conditions to be highly relevant for physiotherapists, none of the suggested examination procedures which every qualified physiotherapist should be capable of were found to be completely irrelevant (figure 6.2). These results emphasize that medical doctors want physiotherapists to be capable of carrying out various examination procedures which, if positive, can be then communicated with the referring physician. This not only ensures good and professional interdisciplinary communication, but also suggests that physicians are positive about Austrian physiotherapists taking responsibility when it comes to assessing different organ systems and the general health status of patients.

6.6. Strengths of the study

A major strength of the current study was that the questionnaire underwent pilot testing on two separate occasions by a panel of medical doctors before being distributed among the physicians. This was done for the matter of clarification and proper order of individual questions (Portney and Watkins, 2009), but also to guarantee that this survey could be completed in a reasonable amount of time (2 minutes). In addition, multiple follow-up reminder notifications were sent to the non-responders after the first two weeks had elapsed (Kanuk and Berenson, 1975; McFarlane et al.,

2007; Portney and Watkins, 2009). This helped enormously to upgrade the final response rate(s).

6.7. Limitations

The central limitation of the current project concerns to the modest return rate(s). 10% of orthopaedic surgeons (n=40 out of 395) and 7.6% of general practitioners (n=76 out of 1000) completed the survey. A generalizability of the current results is therefore problematic. However, the response rates of the current study (10% and 7.6%, respectively) are in line with the return rate by Yusuf and Baron (2006) (8.7%), who conducted a web-based survey among 3054 endoscopists. It has already been stressed that response rates for physicians are generally low (VanGeest et al., 2007) and response rates below 20% are not unusual (Dykema et al., 2011).

Several strategies to maximise response rate(s) within survey related research among physicians have been proposed (VanGeest et al., 2007). In the current study, multiple follow-up reminder notifications were sent to the non-responders after the first two weeks had elapsed (Kanuk and Berenson, 1975; McFarlane et al., 2007; Portney and Watkins, 2009). In addition, research has shown that physicians are more likely to respond to concise surveys (McFarlane et al., 2007). Therefore, the survey was intentionally kept short and could be completed within two minutes. Although there is conflicting evidence which favours closed-ended over open-ended questions (VanGeest et al., 2007), almost all items (except for one follow up question) were presented in a closed ended format. Due to a lack of funding and no additional personnel, neither monetary incentives (James et al., 2011) nor multi-mode strategies for the survey distribution (postal, fax, telephone) (Flanigan and McFarlane, 2008) were possible for the current study. Moreover, no preliminary notification about the upcoming survey was sent to the prospective participants (as this was not feasible with the Bristol online survey tool) (Dykema et al., 2011). Instead of using numerous survey distribution strategies and multi-modal follow up techniques, the current project focused on obtaining a relatively large sampling frame (1400 physicians) in the first place. Berk (1985) has already highlighted the possible advantage of initially casting a wider net (and accept a small response rate) over complex and often expensive multi modal procedures (fax, telephone, postal) to reach unwilling non-responders.

It was not an objective of the current study to investigate the effect of various demographic characteristics (e.g. age, gender, rural versus urban region) on the respondents' attitudes towards physiotherapists making independent keep/refer decisions. Yet, some form of bias within the current study cannot be completely ruled out. The majority of responding orthopaedic surgeons (87.5%) reported making more than 100 referrals to physiotherapy per year. Conversely, no orthopaedic surgeon indicated making less than 20 referrals each year. Consequently, it is impossible to say if orthopaedic surgeons in Austria, who tend to make less than 20 referrals to physiotherapy each year, would have given different answers.

The last limitation concerns the question how many physicians actually read/received the survey. Most physicians (working in a private setting) have office personnel/receptionists which handle the paper work and monitor incoming e-mails (Flanigan and McFarlane, 2008). It is possible that, in some instance, these gatekeepers simply regarded the e-mail containing the link for the survey as spam and subsequently deleted it without telling the physician about its existence (Flanigan and McFarlane, 2008).

6.8. Conclusion

Despite several limitations, the results indicate that the physiotherapists' feedback is relevant for orthopaedic surgeons and even more for general practitioners working in a private setting in Austria. The majority of responding physicians also believe that physiotherapists need to be able to independently assess if patients are suitable for physiotherapy intervention(s), or not. More than half of responding general practitioners and one third of participating orthopaedic surgeons also find it very important that physiotherapists screen patients for the presence of serious medical conditions. The data also gives clear recommendations as to which examination procedures (from the perspective of responding physicians) need to be included in the undergraduate curriculum. In conclusion, the results of the current study are a clear signal that there needs to be a heightened focus on teaching Austrian physiotherapy students how to make precise and independent keep/refer decisions and how to screen patients for the presence/absence of severe pathological processes within a patient's clinical presentation.

6.9. Summary of chapter 6

- Responding physicians deem the ability to make independent keep/refer decisions to be highly relevant for the physiotherapy education and profession.
- Several responding physicians also found it important that physiotherapists screen patients for the presence of serious medical conditions.
- A wide range of different clinical examination procedures as recommended by responding physicians should be included in the physiotherapy undergraduate curriculum.

Chapter Seven

Evaluation of an educational intervention to improve the keep/refer decision making abilities of undergraduate physiotherapy students in Austria: a mixed methods randomised-pilot study.

7.1. Introduction

Chapter five provided a baseline of the current keep/refer decision making competencies of Austrian final year undergraduate physiotherapy students within Europe. The results highlighted the need for additional resources and time for teaching Austrian undergraduate physiotherapy students on how to recognize situations when a medical referral is required. A generally positive attitude of Austrian final year undergraduate students towards screening for serious conditions as part of the education and profession was shown. On the other hand, only the minority of responding students felt that their undergraduate education sufficiently prepared them to recognize serious medical conditions within a patient's clinical presentation.

Chapter six demonstrated that general practitioners and orthopaedic surgeons working in private practice in Austria believed that qualified physiotherapists in Austria should make independent keep/refer decisions. Moreover, responding physicians believed that these clinical decision making competencies should be included in the undergraduate curriculum. In addition, the physiotherapists' feedback about red flags in a patient's health status is important for medical doctors and also influences their further (diagnostic) decision making processes. On the other hand, the current lack of formal training in Austria to recognise serious pathologies as demonstrated in chapter five was confirmed as some responding physicians described instances where qualified physiotherapists in Austria had failed to recognise serious pathologies.

Results from chapter five and six established an evidence base indicating that there may be a potential problem in matching the expectations of autonomous practice as expressed by the Austrian physiotherapy association (Baumgartner, 2013; Bauer-Horvath, 2015; Sorge, 2017; Eckler et al., 2017) and the actual level of education provided in Austria.

The aim of chapter seven was to address the last objective of this thesis:

VI. To evaluate (quantitative and qualitative data) the feasibility and acceptability of a study protocol for a future definitive randomised controlled trial (RCT). This mixed methods randomised pilot study also aims to assess the potential effectiveness of a CBL educational intervention on the keep/refer decision making competencies of Austrian final year undergraduate physiotherapy student based on clinical vignettes.

7.2. Background and study objectives

The development of complex interventions is suggested to follow the Medical Research Council (MRC) framework for the development and evaluation of randomised controlled trials (RCTs) for complex interventions to improve health (MRC, 2000; 2006; Craig et al., 2008; Moore et al., 2015). A special form of complex interventions is educational interventions ‘... targeted on the health professional’ (MRC, 2000:2). To assess whether a future definitive RCT is feasible (Eldridge et al., 2016; Eldridge et al., 2016), feasibility and pilot studies are expected to be carried out prior to a definitive RCT (MRC, 2000). The primary objective(s) of feasibility and pilot studies is to test the workability of a future definitive RCT (Eldridge et al., 2016; Eldridge et al., 2016). A definitive RCT will then primarily assess the efficacy/effectiveness of an intervention (Eldridge et al., 2016; Eldridge et al., 2016). Eldridge et al. (2016) have identified weaknesses/shortcomings of the MRC framework (2000) when it comes to defining feasibility and pilot studies. As a result, these authors developed a framework which uses feasibility as an umbrella term for all studies which are done in preparation of a definitive RCT (Eldridge et al., 2016). Eldridge et al. (2016) propose three different subsets of feasibility studies:

- Feasibility studies (which are not pilot studies).
- Non-randomised pilot studies.
- Randomised pilot studies.

Randomised and non-randomised pilot studies primarily test the execution of the intervention itself (Eldridge et al., 2016). In addition, a randomised pilot study also examines the feasibility of the randomisation process or alternatively tests various possible methods of randomisation. *Feasibility studies (which are not pilot studies) also*

assess whether something can be done and if, how, but they do not incorporate or test certain parts/elements of the study protocol of a RCT. These studies commonly use interviews and/or questionnaires (Eldridge et al., 2016). When it comes to the correct sequence of these different types of studies, Eldridge et al. (2016:15) point out that:

while it may be most common to carry out what we have referred to as *feasibility studies that are not pilot studies* before *non-randomised pilot studies*, and *non-randomised pilot studies* prior to *randomised pilot studies*, the process of feasibility work is not necessarily linear and such studies can be conducted in any order.

Results of this thesis have already highlighted the desire of Austrian final year undergraduate physiotherapy students for additional educational input focusing on how to make accurate keep/refer decisions [please refer to chapter five, figure 5.3, page 112 of this thesis]. In addition, the affirmative position towards teaching physiotherapists how to make accurate keep/refer judgements as part of the undergraduate curriculum from the perspective of Austrian medical doctors has also been demonstrated [please refer to chapter six, figure 6.2, page 136 of this thesis].

As outlined in chapter one of this thesis (section 1.8., page 31), there is an ongoing discussion about future developments within the Austrian health care system (Baumgartner, 2013; Physio Austria, 2014; Bauer-Horvath, 2015; Sorge, 2017) which has resulted in fundamental amendments to the mandatory learning outcomes for new physiotherapy graduates in the case of a future direct access system to physiotherapy in Austria (Eckler et al., 2017). Results from chapter five and six of this thesis, however, established an evidence base indicating that there may be a potential problem in matching the expectations of autonomous practice as expressed by the Austrian physiotherapy association (Baumgartner, 2013; Bauer-Horvath, 2015; Sorge, 2017; Eckler et al., 2017) and the actual level of education provided in Austria. As a direct consequence, it is crucial to find the most efficient way of educating Austrian undergraduate physiotherapy students on how to make sound and autonomous keep/refer decisions and to recognize the presence of serious medical conditions which require attention from another medical specialist.

As summarised in chapter four of this thesis (section 4.2., page 70), the CBL format is generally supported by the literature and perceived as an effective teaching and learning method for educating health professionals including physiotherapy students (McGinty, 2000; Tärnvik, 2007; Srinivasan et al., 2007; Nelson, 2010; Lowe, 2011; Thistlethwaite et al., 2012). Especially in cases of less experienced learners (Srinivasan et al., 2007), CBL seems to be an appropriate educational strategy for improving the keep/refer decision making abilities of undergraduate physiotherapy students in Austria.

So far, the feasibility, acceptability and potential effectiveness of a CBL educational intervention for improving the keep/refer decision making abilities of Austrian undergraduate physiotherapy students has not been assessed. Furthermore, no study so far tried to gain insights from the perspective of Austrian undergraduate physiotherapy students on a) which components of a CBL lecture may be deemed beneficial for making keep/refer decisions, b) which elements during a CBL lecture might have been missing, c) how to foster keep/refer decision making as part of the physiotherapy education from the perspective of students and d) self-perceived difficulties while completing clinical vignettes.

In order to fill these research gaps, an embedded/nested mixed methods randomised pilot study (Halcomb and Hickman, 2015) was carried out.

One advantage of combining quantitative and qualitative research is completeness, which Bryman (2006:106) describes as:

... the notion that the researcher can bring together a more comprehensive account of the area of enquiry in which he or she is interested if both quantitative and qualitative research are employed.

It is acknowledged that several mixed methods research designs exist (Creswell, 2006). However, the embedded/nested design was considered the most appropriate for the purpose of the current study. The justification for choosing the embedded/nested design for the study which forms chapter seven was as follows: According to Creswell (2006:68):

the Embedded Design includes the collection of both quantitative and qualitative data, but one of the data types plays a supplemental role within the overall design.

Moreover, a fundamental feature of the embedded/nested design, as highlighted by Creswell (2006:70-71), is that its intent:

... is not to converge two different data sets collected to answer the same question. Researchers using an Embedded Design can keep the two sets separate

The study which formed chapter seven was an experimental design with primary study outcomes that were purely quantitatively assessed. The secondary outcomes, on the other hand, were predominantly qualitative in nature and were used to answer supplement or different research questions. More detailed information on primary and secondary study outcomes can be found in the following paragraph. In addition, a thorough description of the outcome measures and analytical procedures for primary and secondary study outcomes is described in sections 7.3.4 and 7.3.7 of this chapter.

The primary objectives of the current study were as follows:

- To evaluate the feasibility and acceptability of a study protocol for a future definitive randomised controlled trial (RCT).

The secondary objectives of the current study were as follows:

- To gain insight into the perceptions of participants in the intervention group on:
 - a) Which parts of the lecture were deemed beneficial for making keep/refer decisions (and why)?
 - b) Missing information/elements in the CBL lecture.
- To gain insight into the perception of all participating undergraduate physiotherapy students' on:
 - a) Improvement(s) in the keep/refer decision making competencies of Austrian undergraduate physiotherapy students in the curriculum,
 - b) And difficulties while completing clinical vignettes.

- To assess the potential effectiveness of a CBL educational intervention on the keep/refer decision making competencies of Austrian final year undergraduate physiotherapy student based on clinical vignettes.
- To measure key outcome domains (completions rates, missing data, measures of central tendency and variability of correct keep/refer decisions based on clinical vignettes) for all participating students.

Ethical approval for this study was obtained from the Manchester Metropolitan University Ethics Committee 1390 (Faculty of Health, Psychology and Social Care) (Appendix 2) and from the University of Central Lancashire Ethics Committee STEMH 435 (School of Health Sciences) (Appendix 3).

[Parts of chapter seven have been accepted for publication in the International Journal of Therapy and Rehabilitation. The journal editor's letter of acceptance can be viewed as Appendix 34 on page 319 of this thesis]

7.3. Methods

7.3.1. Study design

This embedded/nested mixed methods randomised pilot study was conducted in accordance with the CONSORT 2010 statement extension for randomised pilot and feasibility studies (Eldridge et al., 2016).

7.3.2. Participants

To obtain a homogenous study sample, this study targeted all final year undergraduate physiotherapy students in Austria. To ensure that the study sample was as homogenous as possible, the study was carried out as close as possible to the end of the third (final) year. As directly recruiting the students was not feasible due to the issue of data protection, the PhD student contacted all heads of the 12 physiotherapy schools in Austria via telephone and e-mail in autumn 2017. These 12 Universities had a total of 469 final year undergraduate physiotherapy students. Seven physiotherapy schools showed a high level of interest in this study. These seven Universities had a total of 310 final year undergraduate physiotherapy students. Subsequently, a date convenient for

participating Universities was arranged. The implementation of the educational intervention and data collection was conducted between February 2018 and June 2018 at the sites of individual Universities in Austria. Whilst participation of the students remained voluntary, the seven heads of physiotherapy schools promised to promote the study. In addition, the heads of physiotherapy schools were asked to distribute a description of the study protocol (Appendix 21) via e-mail among the target population several weeks before the execution of the study. Interested students were then free to show up on the day agreed with individual universities. After a brief oral description of the study protocol by the PhD student, written consent (Appendix 22) from the students present was obtained. No incentives were provided.

7.3.3. Intervention

The description of the educational intervention followed where applicable the guideline for reporting evidence-based practice educational interventions and teaching (GREET) (Phillips et al., 2016).

The educational intervention was administered at each participating University exclusively by the PhD student: The educational intervention consisted of a single, one hour face-to-face CBL lecture on the principles of differential diagnosis, screening for possible red flag pathologies and review of the body systems amongst final year undergraduate physiotherapy students in Austria. This study was done without a follow-up period. Additionally, it was only possible to give one lecture for each University in Austria. The reasons for this were, on the one hand, time constraints from the side of Austrian Universities and students at the end of semester six. On the other hand, the logistical and economical effort for the PhD candidate would have been too big (due to the lack of funding). Yet, the study protocol (one lecture with subsequent written exam) was still in accordance with Boissonnault et al. (2006).

The control group did not receive an active intervention.

By the end of the educational intervention, it was anticipated that students from the intervention group were to:

- a) Have gained a better understanding of the comprehensive approach that is needed to screen patients for the presence of serious pathologies.
- b) Be able to acknowledge the shortcomings of the current approach within the current literature of using individual red flags as diagnostic items instead of clinical warning signs.
- c) Have gained insight into which clinical warnings signs (red flags) might indicate the presence of a serious pathology within a patient's clinical presentation.
- d) Be able to make accurate keep/refer decisions based on clinical vignettes with a higher level of accuracy than students from the control group.

The educational intervention (Appendix 23) was exclusively based on the content of three seminal papers by Boissonnault and Bass (Part I-III 1990) and two more recent reviews by Henschke et al. (2013) and Williams et al. (2013). To avoid any potential errors in the students' understanding as a result of language, the content of all research papers as well as the three cases were summarized and presented by the PhD student in German. The students from the intervention group initially received a 25-minute lecture based introduction (power point presentation) on the principles of differential diagnosis, screening for possible red flag pathologies and review of the body systems (Boissonnault and Bass, Part I-III 1990; Henschke et al., 2013; Williams et al., 2013). Afterwards, three cases (which were also taken from Boissonnault and Bass, Part I-III 1990) were discussed in a CBL format with feedback and guidance from the PhD student. Students were encouraged to actively engage in the clinical decision making and case solving process. The CBL lecture was exclusively conducted by the PhD student who has a six year experience of teaching in a CBL format as a lecturer at the University of Applied Sciences in Krems/Austria.

7.3.4. Outcomes

Eldridge et al. (2016) define study outcomes as 'pre-specified assessments or measurements to address each pilot trial objective ...' (Eldridge et al., 2016:5). Later in this chapter, the analytical section will then specify the 'methods [either qualitative,

quantitative, or both] used to address each pilot trial objective ...' (Eldridge et al., 2016:5).

- The feasibility of a future RCT was analysed in terms of recruitment rates for Universities and students.

Students from both groups were asked to fill out a supplementary questionnaire (Appendix 24) following the completion of the survey containing 11 validated clinical vignettes (Appendix 25) (Mount, 2012). Due to the lack of availability of identical survey instruments, this questionnaire was developed as a bespoke instrument for the purposes of this PhD with feedback from the supervisory team.

- The acceptability of the CBL educational intervention was assessed (as part of the additional questionnaire) by following the theoretical framework of acceptability (TFA) by Sekhon et al. (2017) in terms of affective attitude ('where you generally satisfied with the lecture?'), burden ('do you personally feel that the lecture was too time consuming?') and perceived effectiveness ('do you personally feel that the additional lecture was helpful for you to make accurate keep/refer decisions based on the 11 vignettes?'). The TFA was developed due to a lack of a '... clear, consensual definition of acceptability' (Sekhon et al., 2017:10) within the health care literature. Sekhon et al. (2017) criticised that 'the published literature offers little guidance on how to define and assess acceptability' (Sekhon et al., 2017:1). Assessing the acceptability during the developmental stage of an intervention enables researchers to modify the intervention based on '... experienced acceptability [from the perspective of the recipients]' (Sekhon et al., 2017:11). Students from the intervention group were asked to rate the acceptability of the CBL educational intervention (quantitative data).

- Two open-ended questions (qualitative data) from the additional questionnaire (Appendix 24) were posed to students from the intervention group to explore their perception on:

a) Why certain parts of the lecture were deemed beneficial to help them making accurate keep/refer decisions (Question: 'Which part(s) of the additional lecture did you

personally find most beneficial to help you to make an accurate keep/refer decision based on the 11 vignettes and please state why?').

b) Missing information in the lecture (Question: 'Do you personally feel that the lecture was lacking something which should be included in future lectures?').

- Two additional open-ended questions (qualitative data) from the supplementary questionnaire (Appendix 24) were posed to all participating students to explore their perception on:

a) What they believe should be done as part of the undergraduate curriculum to further improve the keep/refer decision competencies of Austrian undergraduate physiotherapy students (Question: 'How do you personally think can keep/refer decision making abilities be improved?').

b) Self-perceived difficulties when making keep/refer decisions based on the 11 clinical vignettes (Question: 'What did you personally find most difficult when making a keep/refer decision and can you tell us why?').

- To evaluate the potential effectiveness of the CBL educational intervention (keep/refer decision making competencies of all participating students), a survey containing 11 validated vignettes (Mount, 2012) was used (Appendix 25).

The reason for using the 11 vignettes from Mount (2012) for this study and not to continue the use of the 12 vignettes from Jette et al. (2006) was as follows: The 12 vignettes from Jette et al. (2006) had already been used in the cross-sectional survey in chapter five of this thesis. The cross-sectional study also surveyed students from several Austrian universities. As the survey containing the 12 vignettes was distributed among students by using gatekeepers from individual universities, there was the possibility that universities in Austria might have also started using the 12 vignettes from Jette et al. (2006) for their own teaching purposes. This assumption was confirmed when the 12 vignettes from Jette et al. (2006) were used in a Bachelor thesis in 2017 to assess the keep/refer decision making abilities of first, second and third year undergraduate physiotherapy students at the University of Applied Sciences in Salzburg (Koidl, 2017). The continuation of using the 12 vignettes by Jette et al. (2006) for the current study

would have therefore required the exclusion of students from the University of Applied Sciences in Salzburg. This would have led to fewer eligible study participants for the current study.

Students from the intervention group were asked to complete the 11 vignettes immediately after the educational intervention under the supervision of the PhD student. Students from the control group completed the 11 cases immediately following the random allocation process in a separate room under the supervision of an administrator from the University. In accordance with earlier methodology (Jette et al., 2006; Beyerlein, 2010; Vaughn et al., 2011; Schämann et al., 2011; Mount, 2012; Lackenbauer et al., 2018) participating students were instructed to individually decide based on the clinical situation described either to start physiotherapy without additional medical evaluation (keep), treat the patient but also refer for medical examination (keep and refer) or refer the patient for medical check-up without giving any physiotherapeutic intervention (refer). Only one answer option per question was possible. Individual case contents of the 11 vignettes (Appendix 25) were classified as:

- Traditional.
- Medical non-critical.
- Medical critical.

In line with previous research (Beyerlein, 2010; Lackenbauer et al., 2018), students were given a time limit of 14 minutes to complete the 11 vignettes. The 14 minutes for the 11 vignettes were calculated based on previous research by Beyerlein (2010) and Lackenbauer et al. (2018). Beyerlein (2010) and Lackenbauer et al. (2018) gave 15 minutes for the completion of 12 vignettes which equals 75 seconds for each vignette. Replicating these numbers as closely as possible, students from the current study sample were given 14 minutes for the completion of 11 vignettes which equals 76 seconds for each vignette. Giving a time limit which is in line with previous research (Beyerlein, 2010; Lackenbauer et al., 2018) will give the opportunity to compare the results. In addition, a time limit for the completion of the 11 vignettes was set to simulate clinical decisions which are made under time pressure (Veloski et al. 2005). Also replicating previously used methodology (Mount, 2012), a correct answer for the

traditional cases was to treat the patient without the need for medical referral (keep) or to treat the patient with additional medical check-up (keep and refer). A correct answer for the medical non-critical cases was defined if the student(s) chose to start physiotherapy with additional medical evaluation (keep and refer) or refer the patient without physiotherapeutic management (refer). The sole correct answer for medical critical cases was the decision to send the patient for medical evaluation without physiotherapeutic management (refer).

- To measure completion rates and missing data, only students who completed all 11 vignettes were included in the final analysis.

7.3.5. Pre-specified criteria

7.3.5.1. Definition of pre-specified criteria

Eldridge et al. (2016:14) point out that:

The purpose of a pilot trial is to assess the feasibility of proceeding to the next stage in the research process. To do this investigators need some criteria on which to base the decision about whether or not to proceed.

In this context, Eldridge et al. (2016:15) propose:

... to use a traffic light system for criteria used to judge feasibility, whereby measures (e.g. recruitment rates) below a specific threshold indicate that a trial is not feasible, above a higher threshold that it is feasible, and between the two that it might be feasible if appropriate changes can be made.

The authors, however, emphasise that '... such criteria may be best viewed as guidelines rather than strict thresholds that determine progression' (Eldridge et al., 2016:14).

7.3.5.2. Pre-specified criteria for the current study

Even though it is acknowledged that the assessment of potential effectiveness is not a common objective for pilot studies (Eldridge et al., 2016), Eldridge et al. (2016:15) highlight that:

if an [study] objective is to assess potential effectiveness ..., investigators will need to use a standard sample size calculation to ensure there is adequate power.

- A recruitment threshold of at least 74 students was determined to indicate the feasibility of a future definitive RCT in relation to recruitment. This was based on using data from an earlier non-randomised-pilot study at the University of Krems (unpublished data) and the results from chapter five of this thesis (table 5.5, page 104). A sample size of 37 students in each group was calculated to have 90% power to detect a difference in correct keep/refer decisions for the medical critical vignettes in means of 20% (mean for the control group: 46%; mean for the intervention group= 66%) assuming that the common standard deviation was 26% using an unpaired t-test with an alpha level of 5% (two-sided).
- Questions concerning the acceptability of the intervention were exclusively closed ended items. Consequently, quantitative data collection methods were applied. It was felt that at least 75% of the students from the intervention group should approve the acceptability in terms of affective attitude, burden and perceived effectiveness of the educational intervention. This number is in line with Diamond et al. (2014) who suggested a consensus threshold of 75% for Delphi surveys.
- The detection of serious medical pathologies, which require medical evaluation, is a key component of an ongoing discussion about increased practice autonomy for physiotherapists in Austria. The focus of the educational intervention was therefore on teaching students how to recognize the presence of sinister conditions within a patient's clinical presentation which require a referral to a physician. Hence, it was assumed that students from the intervention group would make on the average more accurate answers for the medical critical cases.

7.3.6. Randomisation

The random allocation procedure was conducted identically at each participating University and was administered and monitored by the PhD student: Volunteering students were randomly allocated to the intervention or control group by drawing slips of paper without replacement out of a non-transparent bag. All slips of paper were of equal size but either had a picture of an American Indian (intervention group) or John

Wayne (control group) on them (Appendix 26). Which represented the intervention or control group was not revealed to the students until all slips of paper had been drawn. One half of the students was then led into a separate room. Students from both groups were only then told which group they had been assigned to. The separate room was necessary to separate the control from the intervention group. As blinding of study participants and research personnel was not feasible for the current study, performance bias could not be prevented. As only the experimental group received some educational information (intervention), experimental bias (Hawthorne effect) (Portney and Watkins, 2009) could not be ruled out. As there was no follow-up period, attrition bias (Portney and Watkins, 2009) was irrelevant for the current study.

7.3.7 Analytical methods

- Recruitment rates were analysed using raw counts (percentages and numbers) of participating universities and students in relation to the target population.
- As questions about the acceptability of the educational intervention were closed-ended items (categorical data), the frequencies of responses were presented in raw counts (percentages and numbers) of the study sample.
- Conventional content analysis (Hsieh and Shannon, 2005) was used to analyse the four open-ended questions (Appendix 24). Vaismoradi et al. (2013:400) argued that:

if conducting exploratory work in an area where not much is known, content analysis may be suitable for the simple reporting of common issues mentioned in the data.

Due to the divergent nature of each question, the four open-ended items were analysed separately. For each of the four open-ended questions, repeated patterns (categories) were identified. A category descriptively captures common issues/expressions within a data set also termed manifest content. Conversely, a theme captures an underlying meaning which is also referred to as latent content (Vaismoradi et al., 2013). The analytical process for the four open-ended questions aimed to be purely descriptive. Hence, categories instead of themes were used as the highest level of abstraction for analysing the four open-ended questions.

- Replicating previous methodology (Jette et al., 2006; Beyerlein, 2010; Schämamm et al., 2011; Vaughn et al., 2011; Mount, 2012; Lackenbauer et al., 2018), measurements of central tendency (mean and median) and variability (standard deviation and percentiles) of correct responses for traditional, medical non-critical and medical critical cases for both the control and intervention group were calculated. In addition, percentages of students from both the intervention and control group who made a correct keep/refer decision for 100% of the traditional, medical non-critical and medical critical cases were also analysed.

The potential effectiveness of the educational intervention was evaluated by observing differences of correct keep/refer decisions between the intervention and control group for the medical critical vignettes. As this a pilot study and not a definitive RCT, inferential statistics were not used for comparing the differences of correct keep/refer decisions between the intervention and control group (Eldridge et al., 2016).

- Completion rates and missing data were analysed using raw counts (percentages and numbers) in relation to the study sample.

7.4. Results

7.4.1. Results of primary study objectives

7.4.1.1. Feasibility

The recruitment process started in November 2017 and ended in January 2018. To ensure feasibility, this study aimed at recruiting a total number of at least 74 students. As seen in figure 7.1, heads of physiotherapy undergraduate programmes from seven Universities in Austria (58.3%) initially agreed to take part in the pilot study and distributed a description of the study protocol among their final year undergraduate physiotherapy students. One further University had to be excluded, as no students from this particular University volunteered to participate in the study. The final number of six participating Austrian Universities represented 50% of all Universities in Austria which provide a bachelor degree in physiotherapy.

One student from the intervention group and two students from the control group dropped out after the allocation procedure. The final study sample consisted of a

convenience sample of 116 sixth semester undergraduate physiotherapy students with an equal number of 58 students in the intervention and control group. The total number of study participants represented 24.7% of the target population.

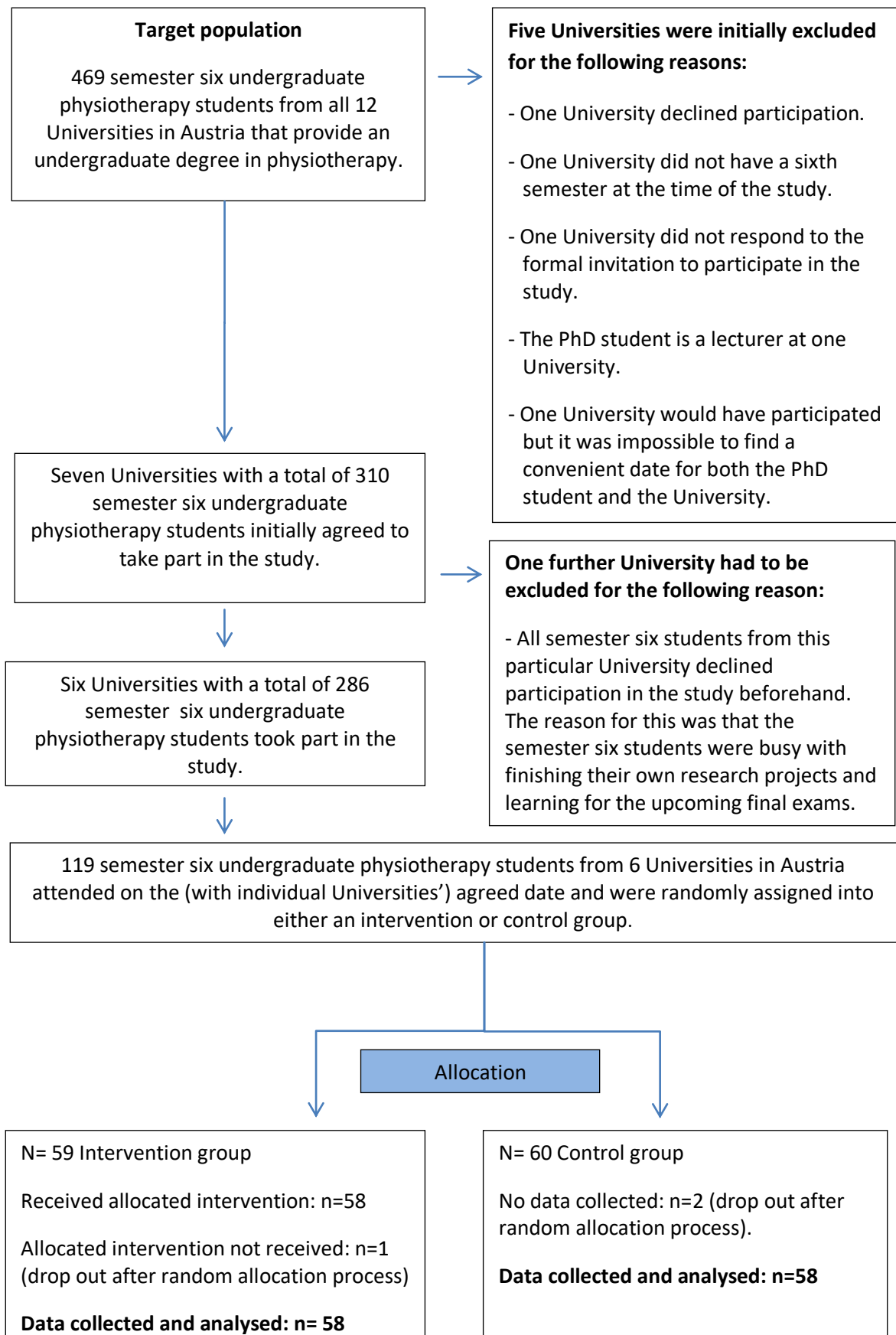


Figure 7.1: Flow diagram for the study.

7.4.1.2. Acceptability

The acceptability of the educational intervention from the perspectives of students from the intervention group was analysed in terms of affective attitude, self-perceived effectiveness and burden.

A benchmark of at least 75% of students from the intervention group approving the educational intervention in terms of affective attitude, perceived effectiveness and burden was determined prior to the start of the study.

The question 'were you generally satisfied with the intervention (lecture)' was used to explore the affective attitude of participants from the intervention group towards the intervention. All students from the intervention group (100%) were satisfied with the intervention.

The item 'do you personally feel that the additional lecture was helpful for you to make an accurate keep/refer decision (based on the 11 vignettes)?' was used to gain insight into the perceived effectiveness of the intervention from the perspective of the intervention group. 77.6% (n=45) of the students from the intervention group found the lecture helpful for completing the 11 vignettes (figure 7.2).

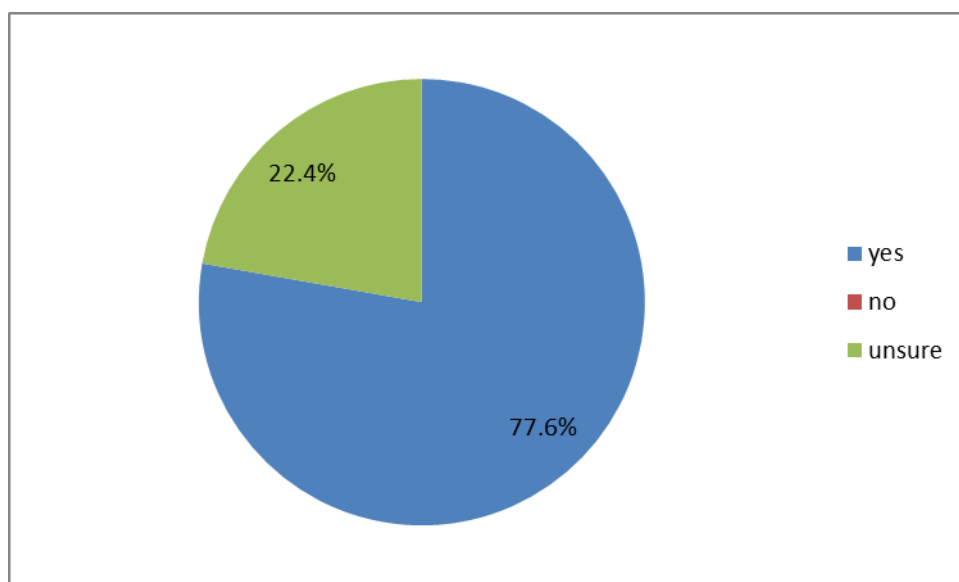


Figure 7.2: Students from the intervention group opinion on self-perceived effectiveness of the educational intervention.

The third aspect of acceptability analysed was burden ('do you personally feel that the intervention (lecture) was too time consuming?'). As presented in figure 7.3, 89.7% (n=52) of students from the intervention group did not deem the intervention too time consuming.

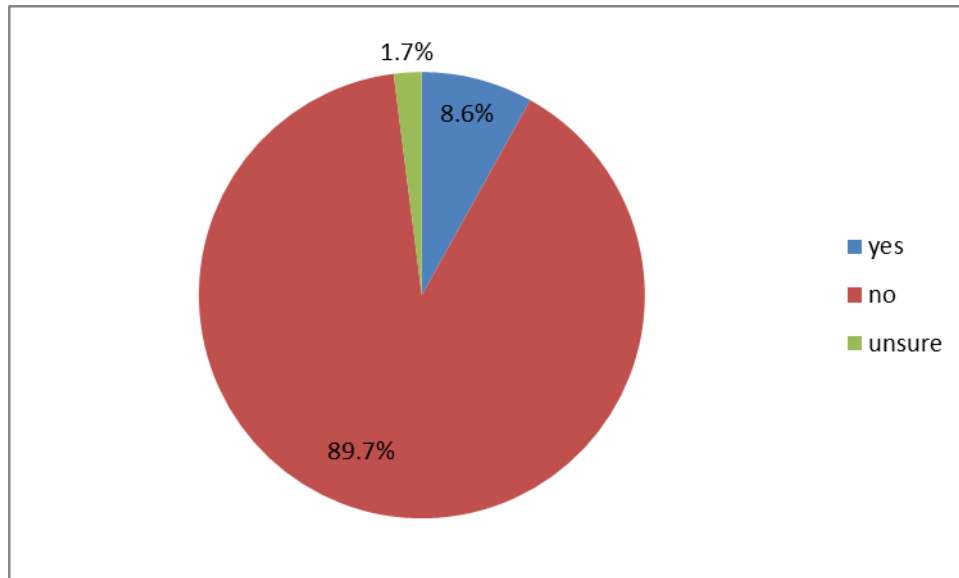


Figure 7.3: Students from the intervention group rating on burden

7.4.2. Results of secondary study objectives

7.4.2.1. Difficulties with the completion of the clinical vignettes from the perspectives of students from the intervention and control group.

As shown in figure 7.4, only a few students from both the intervention and control group found the completion of the clinical vignettes to be easy. Interestingly, more than twice as many students from the intervention group (n=16) as compared to those from the control group (n=7) found the completion of the clinical vignettes to be difficult.

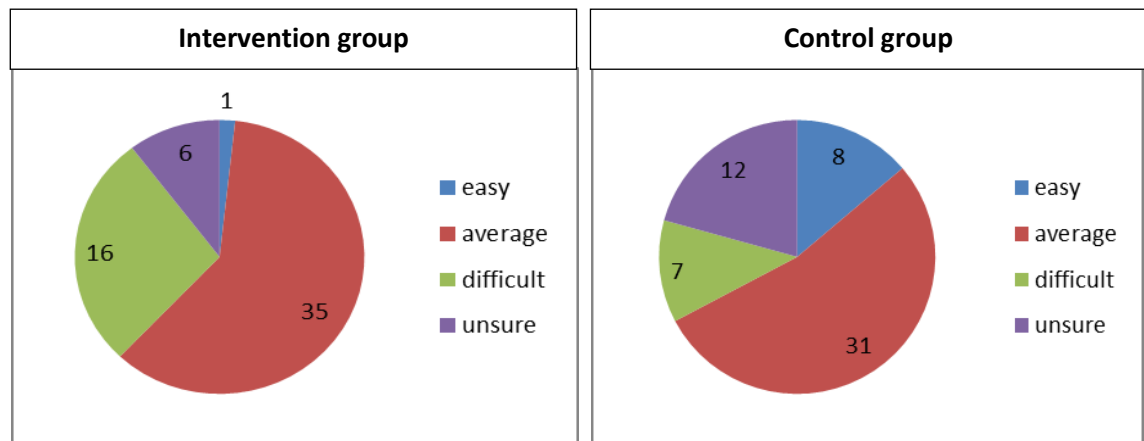


Figure 7.4: Number of students from the intervention and control group who rated their self-experienced level of difficulty when completing the clinical vignettes.

In addition to rating the self-perceived level of difficulty with the completion of the clinical vignettes, students from both groups were also asked to comment on what exactly they found to be most difficult while completing the 11 vignettes. 53 students (91.4%) from the intervention group and 56 students (96.6%) from the control group commented on this issue. As presented in figure 7.5, six distinct categories directly emerged out of the responses (Appendix 27). Students from the intervention and control group highlighted that the inability to conduct additional examination steps or ask follow-up questions when completing clinical vignettes was found to be especially challenging. Moreover, students from both groups had problems with the interpretation of more complex cases. Some students also commented on the fact that they found it difficult to choose between additional medical consultation (keep/refer) and referring the patients without providing physiotherapy at all (refer).

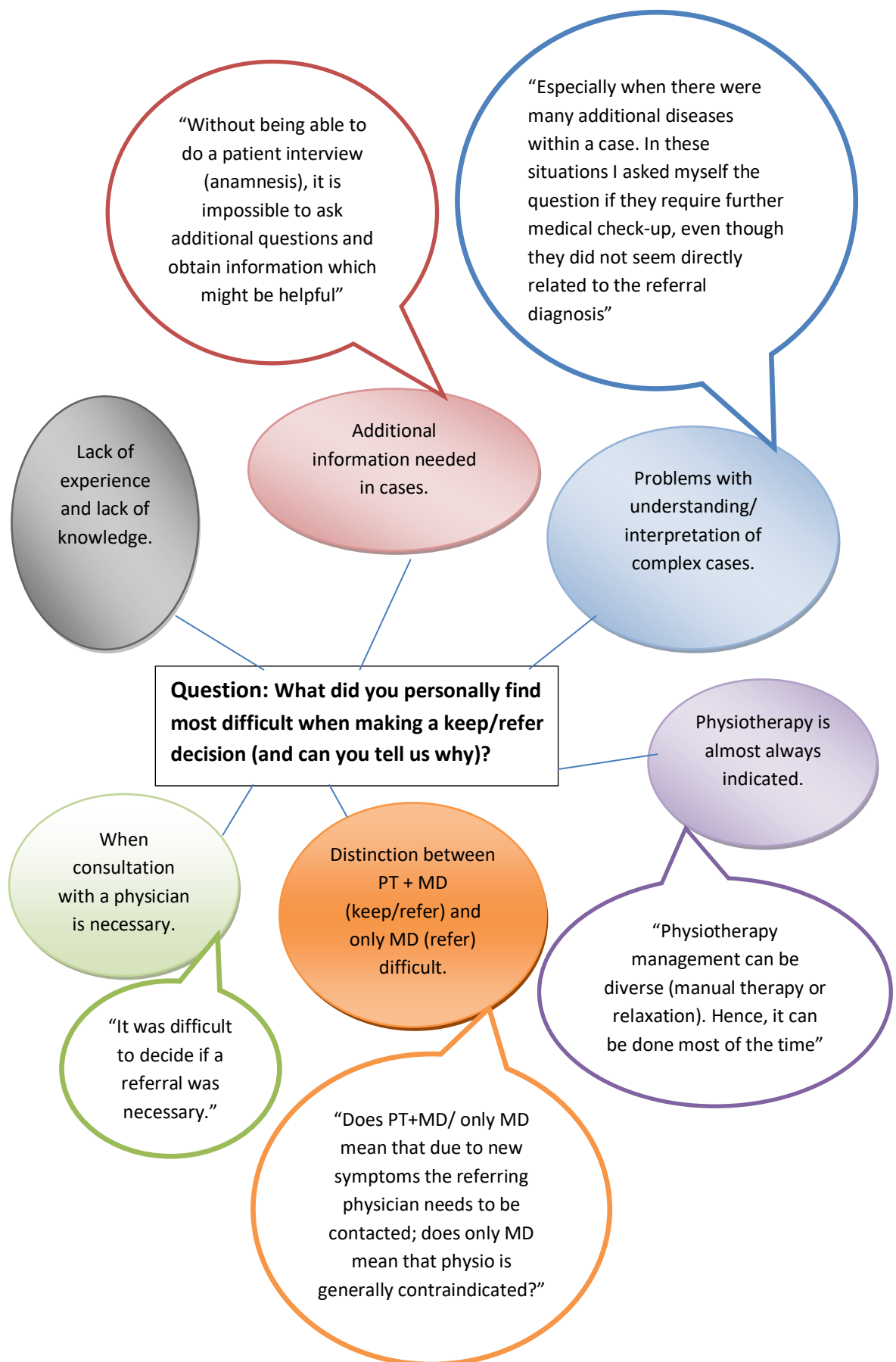


Figure 7.5: What students from both groups found difficult when completing the clinical vignettes.

7.4.2.2. How responding students think keep/refer decision making competencies can be improved?

The question ‘how do you personally think keep/refer decision making abilities can be improved?’ was asked to all participating students. 103 students (out of 116) (88.8%) answered this question. The five categories that emerged out of the students’ responses (Appendix 28) are presented in figure 7.6. Most often responding students commented on the lack of teaching in depth knowledge about individual red flags and pathology during the current undergraduate curriculum. In addition, students from both groups highlighted their desire for greater focus on case discussions during classes.

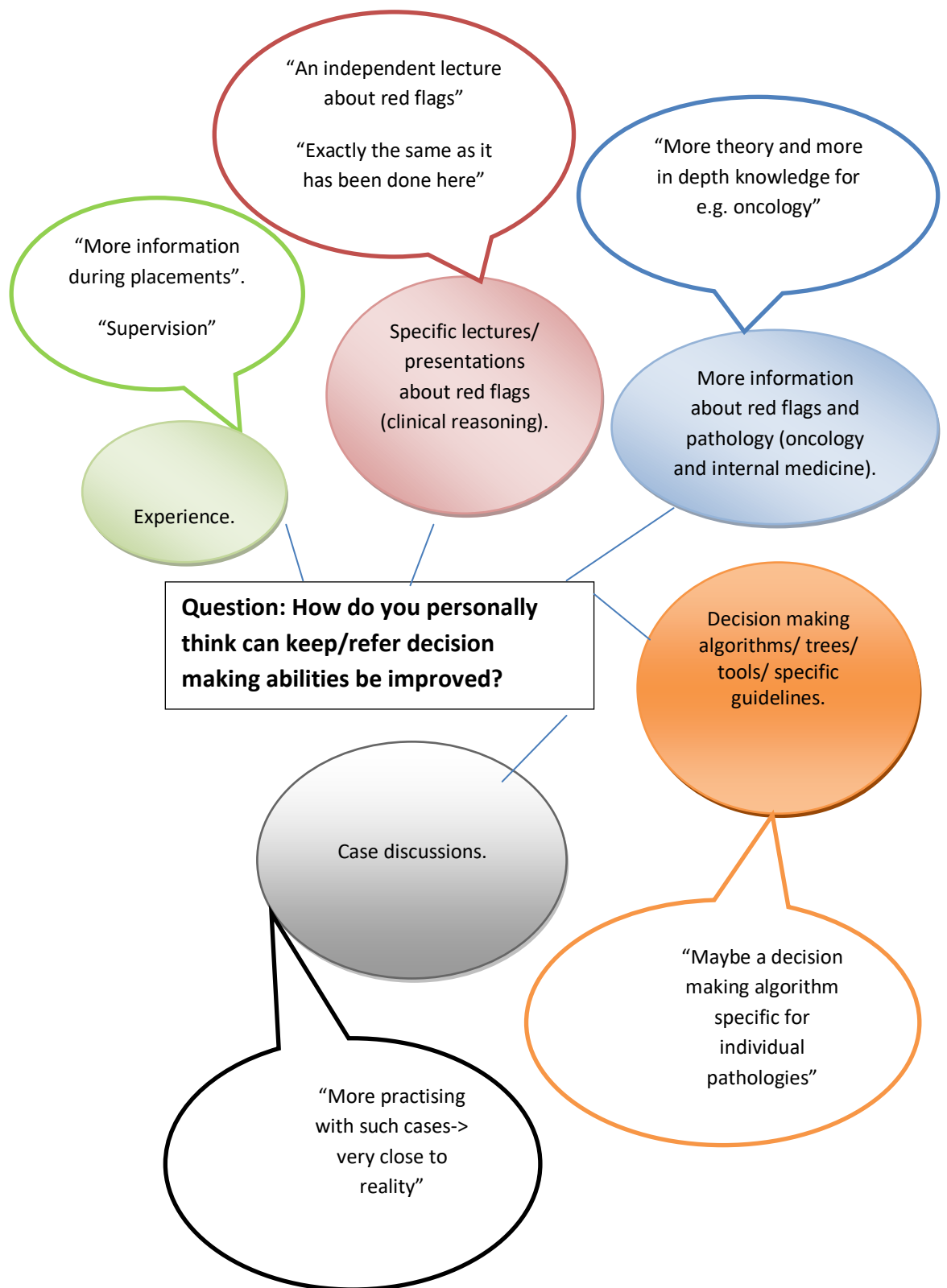


Figure 7.6: How keep/refer decision making abilities can be improved from the perspective of responding students.

7.4.2.3. Which parts of the lecture did students from the intervention group find beneficial for making keep/refer decisions based on clinical vignettes (and why)?

As presented in figure 7.7, more than half of the students from the intervention group (n=34) found the combination of theoretical background and case discussion most helpful for making keep/refer decisions based on clinical vignettes.

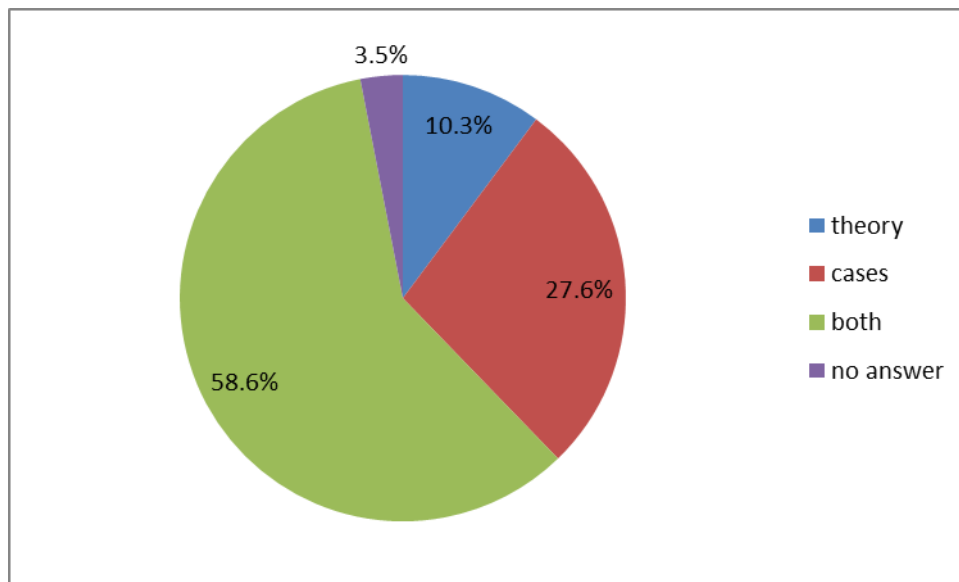


Figure 7.7: Which parts of the lecture were deemed beneficial for completing the clinical cases?

Moreover, 49 students (84.5%) from the intervention group commented on why certain parts of the intervention were deemed more helpful than others while completing the 11 cases. While the theoretical background was reported to be a good repetition of some already acquired knowledge during the undergraduate time, responding students particularly valued the case discussion as this stimulated their clinical problem solving skills and critical clinical reasoning. In addition, the discussion of cases was found to be more practically related than the theoretical background (figure 7.8) (Appendix 29).

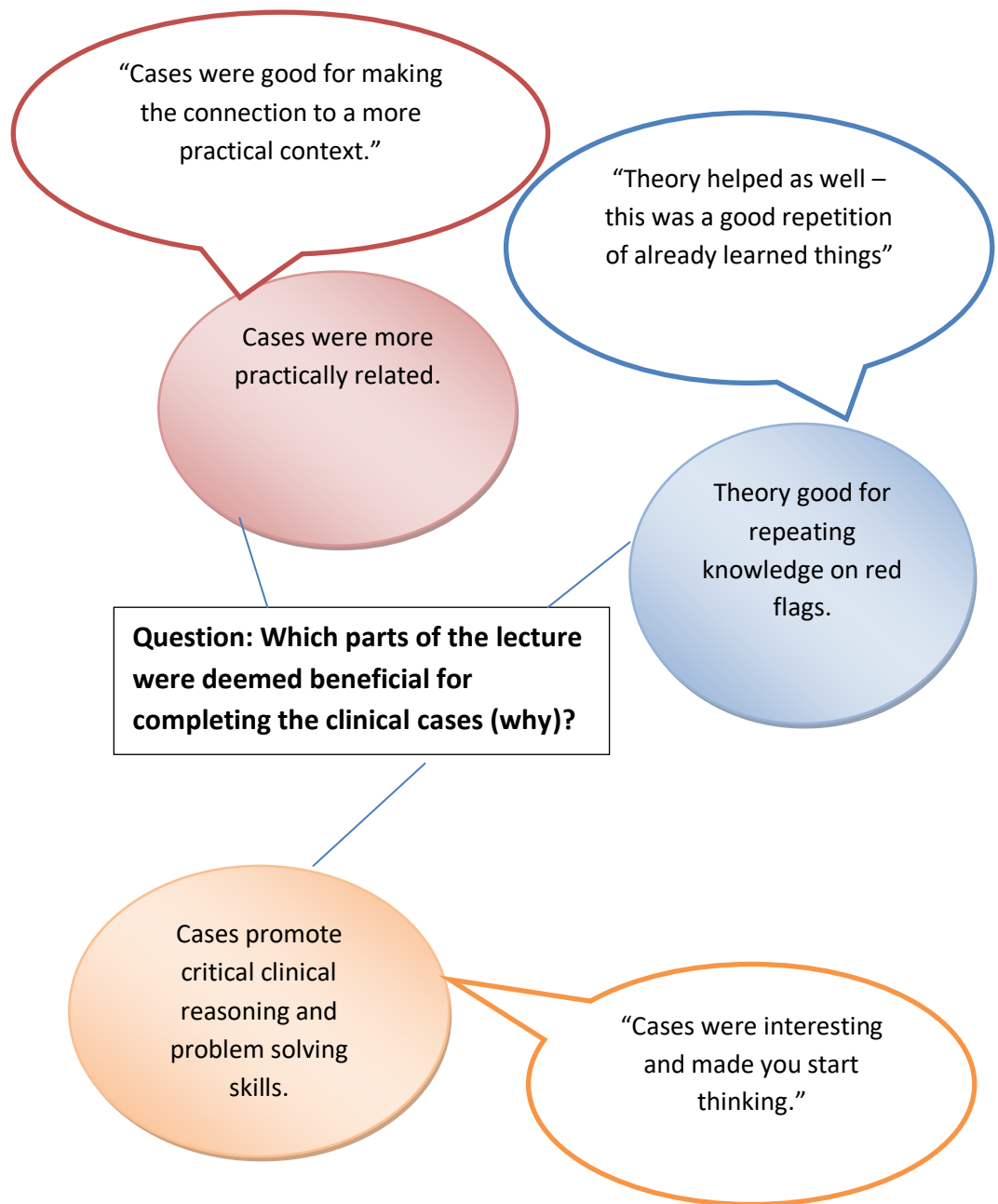


Figure 7.8: Benefit of certain parts of the lecture for making keep/refer decisions based on clinical vignettes.

7.4.2.4. Was the lecture missing something which should be included in future lectures?

32 students (55.2%) from the intervention group answered this question. Most of the time, however, students answered with a simple 'no'. Still, 3 distinct categories were highlighted by responding students (Appendix 30). Firstly, there was the desire for more cases to be discussed within a future lecture. Secondly, it was mentioned that the focus of the educational intervention was too much on spinal pathologies and on how to recognize serious conditions affecting the vertebral column. Thirdly, learning how to properly communicate the findings from the screening procedure with other health professionals should be part of future similar lectures (figure 7.9).

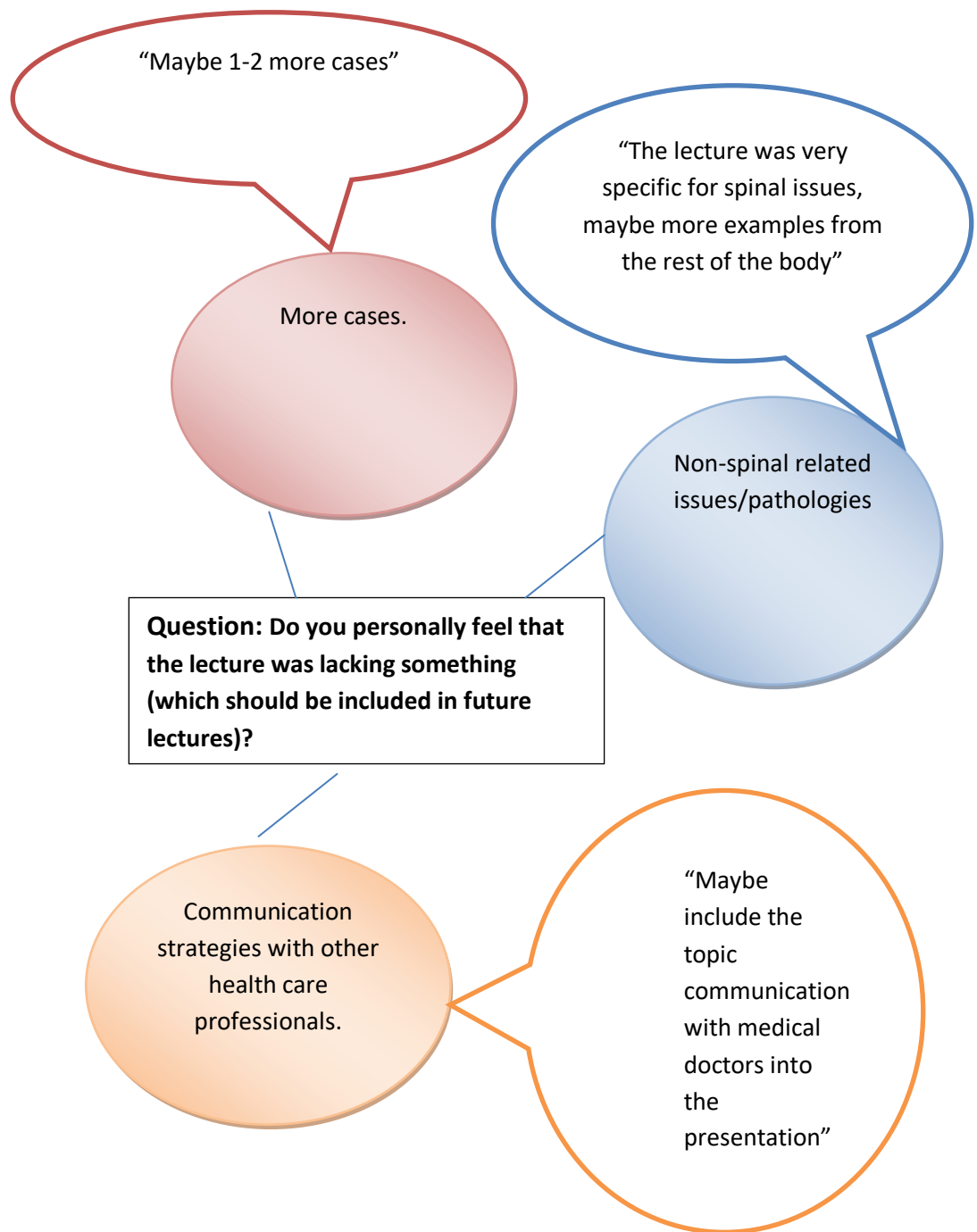


Figure 7.9: Which elements should be included into future lectures?

7.4.2.5. Potential effectiveness of the CBL educational intervention, missing data and completion rates.

All 116 participating students (100%) completed the 11 clinical vignettes. Consequently, all 116 surveys were included in the data analysis. As seen in table 7.1, comparison of the mean and median percentages of accurate keep/refer decisions for the traditional, medical non-critical and medical critical vignettes revealed minor differences between the intervention and control group. The majority of students from both groups managed to make an accurate keep/refer decision for the traditional and medical non-critical vignettes (table 7.1). A correct keep/refer decision for the medical critical cases was made (on the average) in slightly more than half of the cases by both groups (table 7.1).

Table 7.1: Mean and median percentages of correct keep/refer decisions for the traditional, medical non-critical and medical critical vignettes for the intervention and control group.

		Traditional	Medical non-critical	Medical critical
Intervention group	Mean	97.1%	93.5%	52.6%
	Median	100%	100%	50%
	Std. Deviation	9.4%	11.9%	15.3%
	Percentiles	25	100%	93.8%
		75	100%	50%
Control group	Mean	99.4%	88.8%	53.4%
	Median	100%	100%	50%
	Std. Deviation	4.3%	16.9%	21.7%
	Percentiles	25	100%	75%
		75	100%	100%

Descriptive analysis furthermore revealed that only very few students from both groups managed to make an accurate keep/refer decision for all four vignettes from the medical critical category. On the other hand, the majority of students from the intervention and control group made an accurate keep/refer judgement for 100% of the traditional cases (table 7.2).

Table 7.2: Percentages of students from the intervention and control group who made a correct keep/refer decision for 100% of cases within each category.

	Traditional	Medical non-critical	Medical critical
	Yes	Yes	Yes
Intervention group	91.4%	75.9%	1.7%
Control group	98.3%	63.8%	3.4%

7.5. Discussion

This was the first study to examine the feasibility, acceptability and potential effectiveness of a single hour, CBL educational intervention which aimed to improve the keep/refer decision making competencies of Austrian undergraduate physiotherapy students.

Study objective: Assessment of the feasibility of a future RCT in terms of recruitment rates for Universities and final year undergraduate physiotherapy students in Austria.

The importance of physiotherapists and physiotherapy students independently recognizing the presence of serious pathologies within a patient's clinical presentation has repeatedly been the focus of a discussion within the Austrian health care system (Knipp, 2008; Sorge, 2017). There have recently been developments within the Austrian health care sector with physiotherapists being included for the first time as part of a future primary health care system (Physio Austria, 2014). In addition, the Austrian physiotherapy association wants to implement a direct access system to physiotherapy in Austria (Baumgartner, 2013; Bauer-Horvath, 2015; Sorge, 2017). This has resulted in amendments to learning outcomes in the case of a future direct access system for undergraduate physiotherapy studies across Austria (Eckler et al., 2017). In the case of direct access to physiotherapy in Austria, it will be then paramount for new graduates to independently screen patients for the presence of serious pathology which require medical attention. These amendments pose a significant challenge to the future undergraduate physiotherapy education in Austria and are probably a major reason for

the high level of interest in this randomised pilot study from the part of the heads of Austrian physiotherapy schools and final year undergraduate physiotherapy students (figure 7.1). On the other hand, results from chapter five (figure 5.3, page 112) have already demonstrated the Austrian physiotherapy students' desire for independent lecturing on how to properly assess patients for the presence of serious medical pathologies. In addition, a survey among qualified physiotherapists in Austria revealed that qualified physiotherapists in Austria have also recognised the need (in the case of increased practice autonomy) for advanced knowledge on how to autonomously recognise the presence of serious pathologies within a patient's clinical presentation (Sorge, 2017).

Study objective: Assessment of the acceptability of the educational intervention and which parts of a CBL lecture were beneficial from the perspective of students in the intervention group

Students from intervention group enjoyed the CBL educational intervention and, in particular, the in-depth case discussions. This high level of the students' satisfaction with an educational intervention based on CBL is in line with previous reports which have also demonstrated a generally positive attitude towards the CBL method in health care education (Nelson, 2010; Thistlethwaite et al., 2012).

Study objective: Missing information/elements in the CBL lecture.

In addition to recognising the need for a medical referral, some students from the intervention group also wanted to learn more about communication strategies with other health professionals (e.g. medical doctors) (figure 7.9). The importance for physiotherapists and physiotherapy students to (or learn how to) properly report findings which might indicate the presence of a more severe pathological condition has already been highlighted by Goodman and Synder (2013), Boissonnault et al. (2006) and Johnston (2018). In addition to a lecture about medical and red flag screening, one group of students was engaged in active role playing where students learned how to properly report their findings to a physician (Boissonnault et al. 2006). A high level of satisfaction and increased level of confidence for discussing examination findings with

other health professionals were the main advantages of this approach (Boissonnault et al., 2006).

Some students from the intervention group also commented on the fact that the current educational intervention was mainly focused on detecting serious pathologies affecting the spine (figure 7.9). There is an ongoing trend within the current literature to primarily develop strategies which help to identify/exclude severe conditions affecting the vertebral column. Yet, future similar studies should also incorporate best current available evidence to accurately detect/rule out the presence of non-spinal related medical conditions which require medical attention (e.g. fractures of the foot/ankle, fractures of the knee, deep venous thrombosis of the lower limb) [for more detailed information, please refer to Appendix one, page 242 of this thesis].

Study objective: Improvement(s) in the keep/refer decision making competencies of Austrian undergraduate physiotherapy students in the curriculum from the perspective of all participating students

As a result of the high prevalence of low back pain within the general population (van Tulder et al., 2006; GBD 2016 Collaborators, 2017), numerous efforts have been made to develop screening tools that help to accurately rule in or out the presence of serious and/or systemic medical conditions as underlying cause of vertebral pain and, in particular, of the lower back (Henschke et al., 2009; Roman et al., 2010; Shroyer and Mehta, 2013; Germon et al., 2015; Enthoven et al., 2016; Greenhalgh et al., 2016; Greenhalgh et al., 2018; Premkumar et al., 2018). In the context of the education of physiotherapy students in Austria and in particular in the case of a future direct access system, it is paramount that students understand that most patients will present with benign, self-limiting and, most of the time, manageable back pain problems, where spinal imaging procedures are not indicated. At the same time, it is crucial to keep in mind that, even though rare (Henschke et al., 2009, Enthoven et al., 2016; de Schepper et al., 2016; Premkumar et al., 2018; Reito et al., 2018; Galliker et al., 2019), serious (e.g. spinal) pathologies do exist and, if present, require timely medical attention. A possible solution for this dilemma has recently been described by Grunau et al. (2018). Grunau et al. (2018) advocated the use of clinical decision making support systems which have been shown to successfully decrease the number of referrals for spinal imaging in

emergency care settings (Baker et al., 1987; Min et al., 2017). At the same time, no serious medical conditions were missed (Min et al., 2017). For their clinical decision support system, Min et al. (2017) used a 'checklist of accepted red flags for LBP' (Min et al., 2017: 892). Yet, in the absence of firm data about which individual red flags or combination(s) of clinical warnings signs help to accurately rule in/out the presence of serious medical conditions affecting the spine, the existing tools should only be used with caution [for more detailed information on this topic, please refer to chapter three, sections 3.2-3.5., page 45 of this thesis].

In line with the aforementioned discussion about clinical support tools, several students from the current study sample expressed the wish for clinical decision making algorithms/trees/guidelines (figure 7.6). Comparable decision making trees for spinal conditions have been introduced for primary care (Bardin et al., 2017) and for the emergency setting (Singleton and Edlow, 2016). As mentioned throughout chapter three (section 3.2-3.5., page 45) of this thesis, the poor differential diagnostic properties of most red flags for serious spinal pathologies, however, call the applicability and usefulness of such decision making algorithms into question. On the other hand, the usefulness of decision making tools for fractures of the foot/ankle (Bachmann et al., 2003), for fractures of the knee joint (Stiel et al., 1997; Emparanza and Aginaga, 2001), bony fractures of the cervical spine after an acute trauma (Stiel et al., 2009) and proximal deep venous thrombosis of the lower extremities (Wells et al., 1997; Wells et al., 1999; Segal et al., 2007; Geering et al., 2014) have been demonstrated.

Consequently, excluding the Ottawa ankle rules (Bachmann et al., 2003), the Ottawa knee rules (Stiel et al., 1997; Emparanza and Aginaga, 2001), the Canadian C-Spine rule (Stiel et al., 2009) and the Wells Score (Wells et al., 1997; Wells et al., 1999; Segal et al., 2007; Geering et al., 2014) from the undergraduate physiotherapy curriculum should be considered neglectful. It was not part of this thesis to assess the inclusion of clinical prediction rules (CPRs) into the Austrian undergraduate physiotherapy curriculum. The results of two surveys from Australia showed that CPRs (including the Ottawa ankle and knee rules, the Canadian c-spine rule and the Wells Score) were widely unknown to clinical educators in Australia (Knox et al., 2015) and to the majority of responding Australian undergraduate physiotherapy students (Knox et al., 2016). If an identical

survey among Austrian undergraduate physiotherapy students and clinical educators would yield a similar or different picture is, however, unknown.

Some respondents from the current study also highlighted the need for more in-depth education in internal medicine, oncology and pathology (figure 7.6). This notion made good sense, for instance, in the context of the red flag previous history of cancer. It is crucial for all clinicians to have the appropriate level of knowledge about which types of primary cancer have high or low risks of developing bony metastases (Oliver et al., 2011). Clinicians also need to have a solid understanding of the concepts of cancer staging and grading (Goodman and Fuller, 2009; Finucane et al., 2017) so that this information about the extent of the past cancerous disease can assist a clinician in evaluating if a patient has a low, medium or high risk of suffering from metastatic infestation (Oliver et al., 2011; Finucane et al., 2017).

Study objective: Self-perceived difficulties while completing the 11 clinical vignettes from the perspective of students from the intervention and control group

While completing the vignettes from the medical critical category, some students found it hard to choose between physiotherapy and additional medical referral (keep/refer) and the decision to refer the patient without any physiotherapy (refer), especially in vignettes number one, four and six: In vignette number one, a physiotherapist was called to assist a pneumonia patient with ambulation (Mount, 2012). Even though the treating physiotherapist noticed several worrisome clinical features (fever, skin rash, chills, generalised joint and muscle aches), it is still arguable that the walking exercises could have been continued until further medical evaluation was completed. Physical activity (including walking) has been shown to be beneficial in patients with pneumonia (Jose and Dal Corso, 2016). Also in vignette number four, physiotherapy was primarily requested to assist the patient with non-weight bearing ambulation due to a fractured lower leg (Mount, 2012). Although an additional visceral pathology needed to be suspected (Dwiwedi et al., 2010; Gray, 2012), it was still debatable to continue the walking exercises while, at the same time, ordering concomitant medical investigations. The patient in vignette number six had several features that indicated the presence of a deep venous thrombosis (paresis/paralysis, bed ridden, unilateral swelling) (Riddle et al., 2004). Some students also commented that a certain degree of physiotherapy is, in their

opinion, almost always indicated. In the case of vignette number six, it was still arguable to continue physiotherapy (e.g. work on the upper body or the other leg) and leave out the affected limb until further medical evaluation to verify or exclude the presence of a deep venous thrombosis had been done.

The decision between requesting additional medical investigation(s) or refer the patient without providing any physiotherapy might not have been always that clear. Although the answer options in the current study were in line with Beyerlein (2010), Riddle et al. (2004) used a different approach which might be considered for future similar studies. Riddle et al. (2004) asked participating physiotherapists two questions: Firstly, if a patient, in their opinion, had a low, medium, or high risk of suffering from a more serious medical pathology (a deep venous thrombosis in their study)? Secondly, responding physiotherapists should comment on whether they would '... contact the referring physician today about this patient's condition' (Riddle et al., 2004:721)? The advantage of this approach by Riddle et al. (2004) was that it acknowledged the fact that red flags were originally introduced as low grade clinical warning signs for the purpose of assessing the risk of a patient suffering from a more serious pathology and not to make a final diagnosis (Fawkes and Carnes, 2012) [for more in-depth discussion about the use of red flags in the clinical context, please refer to chapter two, section 2.4, page 38 of this thesis].

Several students from the current study sample also commented on their struggle with more complex cases with numerous simultaneously occurring medical pathologies. Students were especially unsure in estimating how concomitant medical diseases might influence a patient's main musculoskeletal pain problem and therefore potentially warrant an (additional) medical check-up. Having recognised this clinical dilemma, George et al. (2015) created a 23-item screening tool for the purpose of assisting practitioners with the identification of signs and symptoms potentially indicating a pathological involvement of one of the major body system (urogenital, pulmonary, cardiovascular, gastrointestinal, endocrine, nervous, integumentary and musculoskeletal) (George et al., 2015). The rationale for this was the assumption that concomitant pathological processes, if remained undetected, would possibly have adverse effects on numerous outcome measures (e.g. pain, functional scores, quality of

life, disability, disease burden) (George et al., 2015). Consequently, such multi morbid patients would be ‘... at risk for poor [treatment] outcomes ...’ (George et al., 2018:471) and a positive response to the 23-item screening instrument might require a more in-depth analysis of a or several organ system(s) and/or a medical referral (George et al., 2015) [for more detailed information on the screening tool by George et al. (2015), please refer to chapter three, section 3.7, page 66 of this thesis].

Study objective: Evaluation of the potential effectiveness of the educational intervention on the keep/refer decision making competencies of participating students based on clinical vignettes

When looking at the results of individual vignettes from the medical critical category, it became obvious that some vignettes seemed to be more demanding than others:

The description of the symptoms in vignette number one was in line with the clinical picture of an infectious, septic or bacterial arthritis (Goodman and Snyder, 2013).

Goodman and Snyder (2013:122) highlight that:

Infectious (bacterial) arthritis should be suspected in an individual [especially in patients over 65 years (Smith et al., 2006)] with persistent joint pain and inflammation occurring in the course of an illness of unclear origin or in the course of a well-documented infection (...) [e.g. respiratory tract infections].

Other typical features, especially in combination that should raise the index of suspicion are elevated temperature (fever > 39°C), skin rashes, joint pain (most commonly of the knee joint), general muscle aches, chills, malaise (Goodman and Snyder, 2013; Smith et al., 2006; Shirliff and Mader, 2002; Mathews et al., 2010). Goodman and Snyder (2013) emphasize, in the case of a suspected infectious arthritis, the need for an urgent medical referral as ‘joint destruction can be rapid’ (Goodman and Snyder, 2013:123). One student from the intervention group decided not to consult a physician at all.

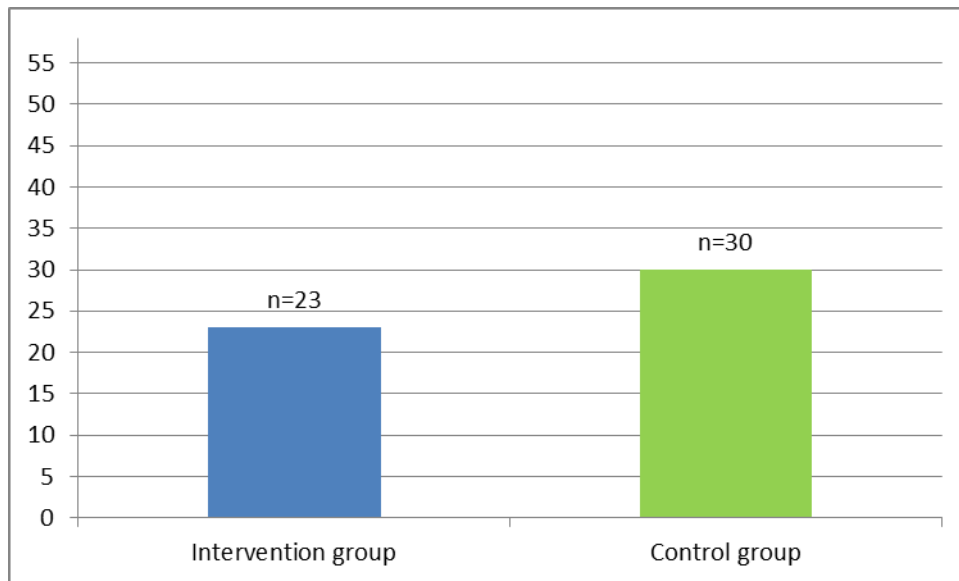


Figure 7.10: Number of students from each group who made a correct decision (refer without physiotherapy) for case number one.

Vignette number four described a 42 year old male who, after being hit in a motor vehicle accident on the driver's side the previous day, complained about constant severe shoulder pain that could not be changed by the physical examination of the shoulder girdle complex. This vignette described the clinical scenario of a possible injury to the diaphragm. Such injuries can happen after blunt trauma (e.g. road traffic accidents) and are more commonly left sided due to the cushion effect of the liver on the right body side (Scharff and Naunheim, 2007; Oikonomou and Prassopoulos, 2011). Pain may be felt especially in the upper part of the shoulder and the trapezius muscle (Dwiwedi et al., 2010; Gray , 2012). Gray (2012:273) described that:

if the diaphragm is the primary source of the patient's referred shoulder pain, then active range of motion (AROM), passive ROM (PROM), and special tests of the shoulder with the patient seated and the thoracic spine in a slumped or flexed position (to minimize stress on the diaphragm) should not increase the patient's pain.

As the patient within vignette number four also had fractured tibia and fibula, it was highly likely that the shoulder examination was done in a non-weight bearing position (e.g. sitting). Consequently, an injury to the diaphragm had to be suspected and an urgent referral for further medical investigation was essential. Yet, only a few students from both groups saw the urgency in this clinical vignette and correctly chose to refer

without any further physiotherapy intervention (figure 7.11). 11 students from the intervention group and 22 students from the control group failed to see the necessity for at least additional medical check-up.

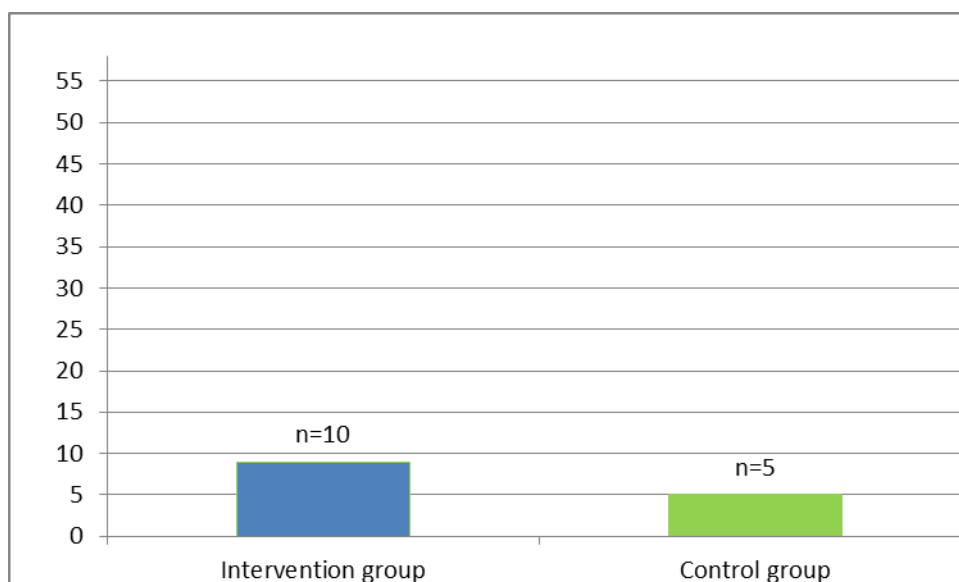


Figure 7.11: Number of students from each group who made a correct decision (refer without physiotherapy) for case number four.

Vignette number six described the clinical scenario of an 18-year old patient with incomplete spinal cord injury after an motor vehicle accident 2 months ago (Mount, 2012). Due to the resulting paresis or paralysis, the fact that this patient was recently (or still is) bedridden and had a unilateral swelling of the lower extremity (3 cm as compared to the non-affected side), a venous thrombosis was highly likely (75%) (Riddle et al., 2004). Consequently, an immediate referral for further specialised investigation was paramount. Encouragingly, no participating student chose to treat the patient without any further medical involvement.

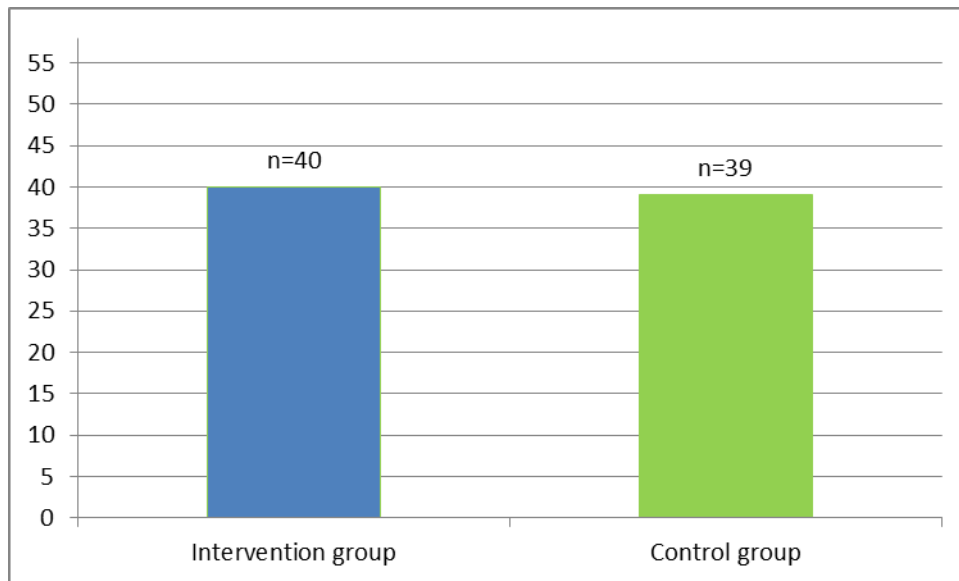


Figure 7.12: Number of students from each group who made a correct decision (refer without physiotherapy) for case number six.

The clinical scenario in vignette number seven described a senior and fragile female patient who fell on her outstretched hand. After the fall, her wrist was swollen, the range of motion was painfully decreased and there was an additional palpable deformity (Mount, 2012). Due to the symptom description, a Colle's fracture was probable (Summers, 2005). Five students from the intervention group and one student from the control group chose to treat the patient without the need for at least additional medical investigation.

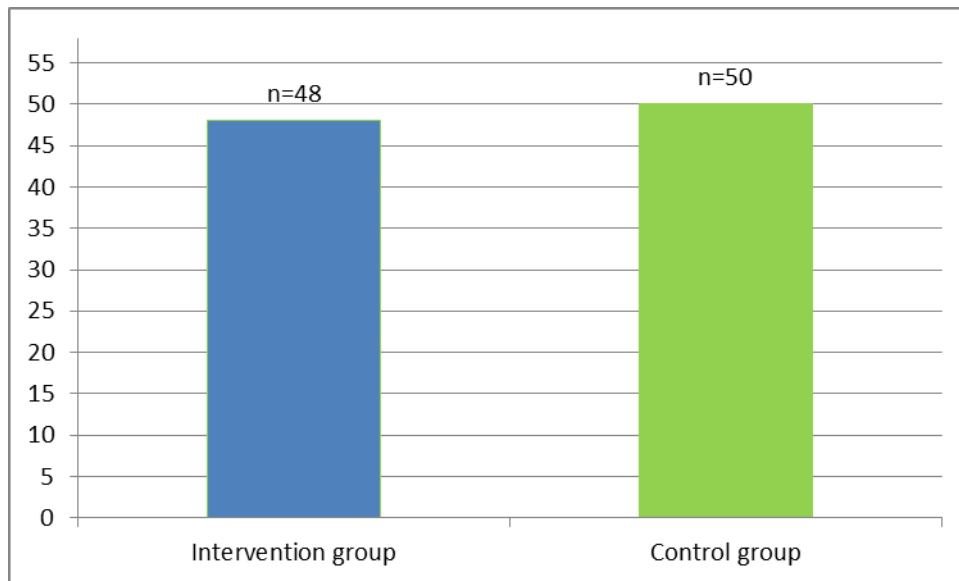


Figure 7.13: Number of students from each group who made a correct decision (refer without physiotherapy) for case number seven.

77.6% of the students from the intervention group found the CBL lecture beneficial for making accurate keep/refer decisions during the completion of the 11 vignettes (figure 7.2). Yet, only half (mean: 52.6%, median: 50%) of the medical critical cases were answered correctly by students from the intervention group. Interestingly, even though this CBL lecture was reported to be helpful for making keep/refer decision making abilities based on the 11 vignettes from the perspective of students from the intervention group, this was not reflected in the results. Students from the intervention group did not make, on the average, more accurate keep/refer decisions than students from the control group. Students from the control group even made, on the average, slightly more correct keep/refer decisions than those from the intervention group (table 7.1). Moreover, more students from the control group made a correct keep/refer decision for 100% of cases from the medical critical category (table 7.2). Even though these differences were rather subtle, it was still unexpected that students from the intervention group would perform worse than students from the control group. Chandra et al. (2017) reported similar results after a one hour intervention which aimed to reduce the number of requested lumbar radiographs for non-traumatic spinal pain. Also unexpected for the authors, their intervention resulted in an increase of ordered radiographs for non-traumatic spinal pain complaints (Chandra et al., 2017). One explanation for their unexpected results was the contrarian effect (Chandra et al., 2017).

This means that study participants reacted to the intervention, but not the way it was originally intended.

In the context of the current study, it has already been reported that clinical decisions based on vignettes do not always necessarily predict decisions when working with real patients (Veloski et al., 2005; Mohan et al., 2014; Brunner et al., 2015). Leerar et al. (2007) and Cooney et al. (2017) have already highlighted deficits in the completeness of the documentation of red flags by physiotherapists for spinal pain. It is currently unknown but worth further evaluation if a similar CBL educational intervention as performed in the current study would make a difference in the students' decision making processes when examining real patients during e.g. the clinical placement. Within clinical vignettes, students from both groups were given the same amount of information. It is worth further evaluation if students from an intervention group are able to recognise and document more relevant and evidence-based red flags than those from the control group when managing real patients. It is also worth further evaluation if students from an intervention group are more capable of recognising the need for medical check-up as compared to those from a control group when working with real patients in a clinical setting.

7.6. Strengths

One advantage of the current study protocol was that the survey with the 11 vignettes was not distributed via e-mail among the prospective study participants. All participating students had to complete the survey in a highly controlled environment under the supervision of either the PhD student (intervention group) or an administrator (control group) from an individual University. This approach was in line with Childs et al. (2005) and was performed for the purpose of preventing students from working together, using other resources or looking up the vignettes online (as the thesis from which the 11 vignettes was in the public domain).

Furthermore, the recruitment process was successful. The total number of 116 study participants represented 24.7% of all sixth semester physiotherapy students in Austria (n=469) and half of all Austrian Universities (n=6 out of 12) that provided an undergraduate physiotherapy degree took part in the study.

Another strength of the current study was the advantageous combination of qualitative and quantitative data collection methods. One advantage of combining quantitative and qualitative research is completeness, which Bryman (2006:106) describes as:

... the notion that the researcher can bring together a more comprehensive account of the area of enquiry in which he or she is interested if both quantitative and qualitative research are employed.

7.7. Limitations

Although clinical vignettes are accepted as valid tools to assess decision making competencies of health care professionals (Peabody et al., 2000; Peabody et al., 2004; Evans et al., 2015; Rousseau et al., 2015), some authors have criticised their uncritical application in health care related research (Veloski et al., 2005; Mohan et al., 2014). Veloski et al. (2005) argued that the answers given by clinicians within clinical vignettes may tend to represent rather idealistic responses and not necessarily the most realistic ones (social desirability bias). Brunner et al. (2015), for instance, demonstrated in their study that there existed a discrepancy between vignettes and real life situations (using simulated patients) when it came to communication and activity related advice given by Swiss physiotherapists. The issue of social desirability bias has been further substantiated by Mohan et al. (2014). Their results revealed poor correlation between transfer decisions based on hypothetical cases (vignettes) as compared to real trauma patients in an emergency department (Mohan et al., 2014).

Another limitation concerned the content validity of the 11 vignettes which were taken from a doctoral thesis by Mount (2012). For the purpose of improving the content validity of the clinical vignettes, Mount (2012) conducted a Delphi survey among six expert physiotherapists and three physicians. All cases that reached a consensus of more than 50% were included in the survey (Mount, 2012). Yet, a consensus threshold of 50% for a Delphi survey is considered relatively low when compared to the average consensus level of 75% (Diamond et al. (2014).

Moreover, due to the lack of funding, the translation of the 11 vignettes into German had to be done by the PhD candidate and did not follow the guidelines for the

comprehensive process of cross-cultural adaption of self-report measures described by Beaton et al. (2000).

Furthermore, this embedded/nested mixed methods randomised pilot study was done without a follow-up period. Additionally, it was only possible to give one lecture for each University in Austria. The reasons for this were, on the one hand, time constraints from the side of Austrian Universities and students at the end of semester six. On the other hand, the logistical and economical effort for the PhD candidate would have been too big (due to the lack of funding). Yet, the study protocol (one lecture with subsequent written exam) was still in accordance with Boissonnault et al. (2006).

An important issue applies to non-response bias. Students from all volunteering Universities were given preliminary information about this study (Appendix 21). It was therefore likely that only students took part that were generally interested in the topic and also felt comfortable with the completion of clinical vignettes.

Finally, RCTs are considered by some authors as the gold standard for evaluating the efficacy/effectiveness of educational interventions (Torgerson, 2002; Goldacre, 2013). In addition, the development of complex interventions is suggested to follow the Medical Research Council (MRC) framework for the development and evaluation of randomised controlled trials (RCTs) for complex interventions to improve health (MRC, 2000; 2006; Craig et al., 2008; Moore et al., 2015). A special form of complex interventions is educational interventions ‘... targeted on the health professional’ (MRC, 2000:2). Hence, the mixed methods randomised pilot study in chapter seven of this thesis was conducted on the assumption that the results will help to inform the development of a future RCT which will then assess the efficacy/effectiveness of a similar educational intervention. However, others have questioned the usefulness of RCTs to assess the efficacy/effectiveness of educational interventions (Prideaux, 2002; Norman, 2003; Sullivan, 2011; Rowe and Oltmann, 2016) because ‘... randomisation does not control for other sources of variations and confounding factors that are likely to be found in educational contexts’ (Rowe and Oltman, 2016:7). Hence, future similar studies might also consider the use of different study designs for assessing the efficacy/effectiveness of educational interventions which aim at improving the keep/refer decisions of physiotherapy students. A more comprehensive discussion about the application,

advantages and disadvantages of different study designs for educational research will be presented in chapter nine, section 9.3, page 205 of this thesis.

7.8. Conclusion

A single-hour CBL educational intervention which aimed to improve the keep/refer decision making abilities of Austrian undergraduate physiotherapy students was found to be feasible and acceptable. 50% (n=6 out of 12) of Austrian Universities took part in the study. The total number of 116 study participants represented 24.7% of all final year Austrian undergraduate physiotherapy students. 100% of students from the intervention group were satisfied with the intervention (affective attitude) and 77.6% found the intervention beneficial for making keep/refer decisions based on clinical vignettes (perceived effectiveness). 89.7% did not find the intervention too time consuming (burden). A potential effectiveness of the CBL educational intervention could, however, not be demonstrated. Students from the intervention group did not make, on the average, more accurate keep/refer decisions for vignettes from the medical critical category than students from the control group. Although the potential effectiveness of the educational intervention was not a primary study outcome, this pre-specified criterion was not fulfilled. Consequently, the progression towards a definitive RCT with the primary aim to assess the efficacy/effectiveness of this single hour, CBL educational intervention is not recommended.

Apart from the discussion about the progression towards a future more definitive RCT, this mixed methods randomised pilot study was an essential step towards the development of a curriculum that should adequately prepare Austrian undergraduate physiotherapy students for the future challenge of increased practice autonomy for Austrian physiotherapists.

7.9. Summary of chapter 7

- A single-hour CBL educational intervention which aimed to improve the keep/refer decision making abilities of Austrian undergraduate physiotherapy students was found to be feasible and acceptable.
- The potential effectiveness of a single hour, CBL educational intervention based on the principles of differential diagnosis, screening for red flag pathologies and review of the body systems could not be demonstrated. Therefore, the progression towards a more definitive RCT is currently not recommended.
- The students' feedback will assist the preparation of future similar studies and the development of a curriculum which aims to improve the keep/refer decision making competencies and recognition rates of serious pathologies of Austrian undergraduate physiotherapy students.

Chapter Eight

Discussion and conclusion

8.1. Introduction

This thesis was initiated in the light of developments within the Austrian health care sector with physiotherapists being included for the first time as part of the planning for how the national health care system should be developed (Physio Austria, 2014). In addition, there is an ongoing effort from the Austrian physiotherapy association to implement a direct access system to physiotherapy in Austria (Baumgartner, 2013; Bauer-Horvath, 2015; Sorge, 2017). This has resulted in amendments to the learning outcomes for undergraduate physiotherapy studies across Austria (Eckler et al., 2017). Opponents of direct access to physiotherapy services primarily express concern that physiotherapists might fail to recognize the presence of serious medical conditions, which require medical evaluation and/or treatment (Deyle, 2006; Jette et al., 2006; Leemrijse et al., 2008; Foster et al., 2012; Shoemaker, 2012; Piano et al., 2017).

Working in a direct access setting entails a high level of responsibility for physiotherapists. The Austrian physiotherapy association's ongoing desire for more practice autonomy warrants the development of an evidence based curriculum that properly prepares Austrian physiotherapy students and newly qualified physiotherapists to make accurate and autonomous keep/refer decisions and recognise the presence of serious pathologies which require a referral to a physician. In light of this discussion, chapter five, six and seven aimed to address the following four research gaps:

● **Research gap one:** So far, the keep/refer decision making competencies of Austrian final year undergraduate physiotherapy students within Europe have not been assessed.

Outcome: This thesis highlighted that Austrian final year undergraduate physiotherapy students are currently insufficiently trained to detect serious pathologies which require a medical referral based on clinical vignettes (chapter five, section 5.3.4., page 105 and chapter seven, section 7.4.2.5., page 174). In comparison with participants from other European countries (e.g. Denmark, Finland, Germany and Spain), the performance of Austrian final year undergraduate physiotherapy students was similar, or only

marginally inferior. Participating students from the Netherlands and Estonia, however, made on average more accurate decisions for cases from the medical critical category (chapter five, section 5.3.4., page 105). The current lack of formal training to recognise serious pathologies was confirmed as some responding physicians described instances where qualified physiotherapists in Austria had failed to recognise serious pathologies in patients who had also previously been seen by a physician and then referred to physiotherapy (chapter six, figure 6.3, page 140).

● **Research gap two:** What is the opinion and attitude of different stakeholders in Austria (undergraduate physiotherapy students and physicians) towards Austrian physiotherapists making independent keep/refer decisions and screen patients for the presence/absence of serious pathologies as part of the undergraduate education and profession?

Outcome: All responding physiotherapy students in Austria believed that screening for serious pathologies is not exclusively the task of physicians (chapter five, figure 5.4, page 114). The majority of responding physicians also deemed the ability to make autonomous keep/refer decisions to be highly relevant for Austrian physiotherapy education and for the profession as a whole (chapter six, section 6.4.2., page 135). The importance for physiotherapists to recognise the presence of serious pathologies (especially in the case of direct access to physiotherapy) is also consistent with the opinion of qualified physiotherapists in Austria (Sorge, 2017).

● **Research gap three:** Which clinical examination procedures Austrian medical doctors believe every qualified physiotherapist should be capable of?

Outcome: Austrian physicians suggested a wide range of different clinical examination procedures (e.g. neurological examination, palpation of peripheral pulses and of the lymph nodes, examination of cranial nerves) which should be mandatorily included in the undergraduate curriculum (chapter six, figure 6.2, page 138).

● **Research gap four:** The feasibility, acceptability and potential effectiveness of a study protocol including a CBL educational intervention which aims to improve the keep/refer decision making competencies of Austrian final year undergraduate physiotherapy students have not been assessed.

Outcome: Results of this thesis found a single-hour CBL educational intervention which aimed to improve the keep/refer decision making abilities of Austrian undergraduate physiotherapy students to be feasible and acceptable (chapter seven, section 7.4.1.1. page 161 and section 7.4.1.2., page 164). A potential effectiveness of a single-hour, CBL educational intervention could however not be demonstrated (chapter seven, section 7.4.2.5., page 174).

In conclusion, the original contribution to knowledge of this thesis comprises two major issues of concern. These will be outlined and discussed in detail below in the context of existing literature:

8.2. Deficiencies in the current undergraduate training in Austria to recognise serious pathologies.

Deficiencies in the current Austrian undergraduate curriculum to recognise serious pathologies were identified as:

- Inadequate focus on recognition of serious pathologies in the current university education in Austria.
- A lack of decision making support systems (evidence based clinical guidelines).
- A lack of experience of final year undergraduate physiotherapy students in Austria.

These three issues of concern will be further discussed below:

Inadequate focus on recognition of serious pathologies in the current university education in Austria.

Previous studies on qualified physiotherapists in the United States (Riddle et al., 2004; Jette et al., 2006; Cross et al., 2011; Mount, 2012), Germany (Beyerlein, 2010), Switzerland (Schämann et al., 2011) and on DPT students in the United States (Vaughn et al., 2011) have revealed a lack of knowledge to accurately detect severe pathological conditions based on clinical vignettes. These results were more recently confirmed by Ladeira (2018) who demonstrated the inability of qualified physiotherapists in the United States to accurately recognise signs and symptoms of a serious pathology (ectopic pregnancy masquerading as mechanical low back pain) as described in a clinical

vignette. Results of chapter five were in line with these previous findings and demonstrated that Austrian final year undergraduate physiotherapy students were not sufficiently educated to accurately detect serious pathologies based on clinical vignettes. Austrian final year undergraduate physiotherapy students made on average a correct keep/refer decision in 46% of the vignettes from the medical critical category. In comparison, participants from the Netherlands made on average a correct keep/refer decision in 62% of cases from the medical critical category. It should be noted at this stage that physiotherapists in the Netherlands have already been working in a direct access setting for more than a decade (Leemrijse et al., 2008). Hence, the recognition of serious pathologies is an important component of both the Dutch standards for the physiotherapy profession (Lackenbauer et al., 2017) and also of the physiotherapy undergraduate education in the Netherlands (Klein et al., 2018). Results from chapter five were more recently confirmed by Klein et al. (2018) who highlighted weaknesses of German final year undergraduate physiotherapy students to recognise the presence of serious medical conditions based on clinical vignettes. The majority of Austrian students in chapter five admitted that they felt poorly equipped to make autonomous keep/refer decisions and to recognise serious pathologies within a patient's clinical presentation. These results were not unexpected, as a review by Lackenbauer et al. (2017) (Appendix 31) revealed that red flag screening is neither an important component of the current educational nor the professional guidelines for physiotherapists in Austria. However, this does highlight a potential issue going forwards as recent changes within the mandatory learning outcomes in the case of future direct access to physiotherapy in Austria (Eckler et al., 2017) require new physiotherapy graduates to be able to screen patients for the presence of serious pathologies which require attention by another health care provider (e.g. a physician). Another critical finding from chapter five was that neither screening for serious pathologies nor the subsequent documentation of red flag items seemed to be an important component during clinical placements. Only half of the responding Austrian students were explicitly instructed by their supervisors to screen patients for the presence of serious conditions. In addition, less than half of the responding students reported that the documentation of red flags during clinical placements was imperative. Incomplete patient records by physiotherapists with regards to red flags have already been reported by others in the past (Leerar et al.,

2007; Cooney et al., 2017). In the case of future direct access to physiotherapy in Austria, physiotherapy students need to be instructed to obtain all relevant medical information as part of the physiotherapy assessment during clinical placements. In addition, this information needs to be properly documented. The Austrian physiotherapy association currently seeks more practice autonomy for physiotherapists in Austria (Baumgartner, 2013; Bauer-Horvath, 2015; Sorge, 2017). This is in line with a literature review by Boissonnault and Ross (2012) which demonstrated that through a skilled and comprehensive clinical decision making process which combines several aspects from the patient's interview, various risk factors and the physical assessment, physiotherapists are capable of detecting a wide range of pathologies that are not amenable by physiotherapy. However, physicians surveyed in chapter six described several instances where Austrian physiotherapists have failed to recognise the presence serious medical conditions, in patients referred by physicians. This highlights the urgent need to properly educate Austrian physiotherapy students and qualified physiotherapists on how to make accurate keep/refer decisions and screen patients for the presence of serious pathologies which are not amendable by physiotherapy.

A lack of decision making support systems (evidence based clinical guidelines).

Results from chapter five showed that Austrian final year undergraduate physiotherapy students were not able to detect the presence of serious pathologies based on clinical vignettes with a high level of accuracy. Austrian final year undergraduate physiotherapy students made on average a correct decision in less than half (46%) of cases from the medical critical category (section 5.3.4., page 105). Furthermore in chapter six, some responding physicians reported instances where qualified physiotherapists in Austria failed to recognise the presence of serious pathologies (figure 6.3, page 140). As results from chapter five and six established an evidence base indicating that there may be a potential problem in matching the expectations of autonomous practice as expressed by the Austrian physiotherapy association (Baumgartner, 2013; Bauer-Horvath, 2015; Sorge, 2017) and the actual level of education provided in Austria, chapter seven was designed to gain in depth insights into the specific experience of Austrian undergraduate physiotherapy students and to recognise the barriers and challenges they face. In order to improve their keep/refer decision making competencies, several participating

students in chapter seven expressed the wish for clinical decision making algorithms/trees/guidelines. Comparable decision making trees for spinal conditions have been introduced for primary care (Bardin et al., 2017) and for the emergency setting (Singleton and Edlow, 2016). Grunau et al. (2018) advocated the use of clinical decision making support systems which have been shown to successfully decrease the number of referrals for spinal imaging in emergency care settings (Baker et al., 1987; Min et al., 2017). Furthermore, risk assessment tools have been introduced for many other medically serious conditions, including detecting/excluding spinal cancer (Deyo and Diehl, 1988; Premkumar et al., 2018), osteoporotic fractures of the spine (Henschke et al., 2009; Roman et al., 2010; Verhagen et al., 2016), spinal infection (Shroyer and Mehta, 2013; Yusuf et al., 2018; Premkumar et al., 2018) and guidelines for the detection of a compression of the cauda equina (Germon et al., 2015; Greenhalgh et al., 2018). As described in chapter three of this thesis (sections 3.2.-3.5, page 45), in the absence of firm data about which individual red flags or combination(s) of clinical warnings signs help to accurately rule in/out the presence of serious medical conditions affecting the spine, the existing tools should only be used and taught by acknowledging their limitations for clinical application. On the other hand, the usefulness of decision making tools has previously been demonstrated in other conditions, including fractures of the foot/ankle (Bachmann et al., 2003), for fractures of the knee joint (Stiel et al., 1997; Emparanza and Aginaga, 2001), bony fractures of the cervical spine after an acute trauma (Stiel et al., 2009) and proximal deep venous thrombosis of the lower extremities (Wells et al., 1997; Wells et al., 1999; Segal et al., 2007; Geering et al., 2014) (Appendix one, page 242).

A lack of experience of final year undergraduate physiotherapy students in Austria.

Some students in chapter seven also commented on their lack of experience which made it difficult for them to make accurate keep/refer decisions based on clinical vignettes (section 7.4.2.2., figure 7.6, page 169). In line with this, more years of experience has already been shown to positively influence the keep/refer decision making competencies of physiotherapists (Beyerlein, 2010; Vaughn et al., 2011; Schämann et al., 2011; Cross et al., 2011). In this context, Henschke et al. (2007) described the term ‘...overall clinical judgement...’ (Henschke et al., 2007:1673) which had a pooled positive likelihood ratio of 12.1 when looking for spinal malignancy. Similar

to overall clinical judgement, Verhagen et al. (2017) describe ‘...strong clinical suspicion...’ (Verhagen et al., 2017:1860), which had a positive likelihood of 12.0-54.2 for identifying vertebral cancer. It is believed that overall clinical judgement/strong clinical suspicion describe the gut feeling that something about the patient’s clinical presentation does not fit. It is the clinician’s subjective feeling that there might be something fundamentally wrong with this patient and therefore additional medical examination is warranted. This third sense that something seems wrong with a patient’s clinical presentation is acquired over many years of working with patients on a daily basis. Yet, the mandatory learning outcomes after a three year undergraduate physiotherapy degree mandate that new graduates need to be able to recognise the presence of serious medical conditions which require a medical referral (Eckler et al., 2017). However, it is highly doubtful that this form of gut feeling can be acquired during a three year undergraduate degree with limited hours of clinical placements.

8.3. Progression towards RCT for testing improved undergraduate training to recognise serious pathologies.

The second issue of concern is divided into two categories which will be discussed below:

Feasibility and acceptability

A single hour CBL educational intervention was found to be feasible and acceptable. These results confirm those from previous studies which have already demonstrated a generally positive attitude towards the CBL method (McGinty, 2000; Tärnvik, 2007; Srinivasan et al., 2007; Nelson, 2010; Lowe, 2011; Thistlethwaite et al., 2012) [for more information, please refer to chapter four, section 4.2., page 70 of this thesis]. Results from chapter five of this thesis have already highlighted the desire of Austrian undergraduate physiotherapy students for an independent lecture in keep/refer decision making and red flag screening (section 5.3.5., figure 5.3, page 112).

Potential effectiveness

The results from chapter seven failed to demonstrate a potential effectiveness of a single hour CBL educational intervention. It should be noted that a primary goal of pilot studies is not to assess the efficacy/effectiveness of an intervention (Eldridge et al., 2016). The primary objective(s) of pilot studies is to test the workability/feasibility of a future definitive RCT (Eldridge et al., 2016; Eldridge et al., 2016). A definitive RCT will then primarily assess the efficacy/effectiveness of an intervention (Eldridge et al., 2016; Eldridge et al., 2016). However, a pilot study can be used to evaluate the potential effectiveness of an intervention (Eldridge et al., 2016). Consequently, the supplement of a single hour CBL lecture is not sufficient to improve the keep/refer decision making abilities and, most importantly, the recognition rates of serious pathologies of Austrian final year undergraduate physiotherapy students based on clinical vignettes. The result of a failed potential effectiveness was not unexpected. Study participants in previous studies by Karges et al. (2013) and Childs et al. (2005) received more formal training in differential diagnosis and clinical decision making. Study participants in Karges et al. (2013), for instance, underwent 50 hour training in emergency medicine which helped them with their decision making processes related to acute and potentially serious sporting injuries. Childs et al. (2005) demonstrated that physiotherapy students and qualified physiotherapists working in the United States Armed Forces possess a superb medical and (differential) diagnostic level. However, they represent a rather distinct group who usually receive additional extensive postgraduate training in neuro-musculoskeletal examination and triage. Due to a lack of funding and logistical barriers from participating universities, more contact hours over a longer period of time (e.g. over the course of several weeks) were infeasible for the current study which formed chapter seven. Still, the study protocol (one lecture with subsequent written exam) was still in accordance with previous research by Boissonnault et al. (2006).

As recommended by Bugge et al. (2013), it is important to state which changes/adaptions to the intervention itself or the study design are necessary before the progression towards a definitive RCT can be recommended. These suggestions are outlined in chapter nine (section 9.3, page 204) of this thesis.

8.4. Conclusion

The results of this thesis have highlighted two issues of concern which are an important step towards the development of a curriculum which will improve the keep/refer decision making abilities and recognition rates of serious pathologies of Austrian undergraduate physiotherapy students. This becomes especially relevant as the Austrian physiotherapy association wants to implement a direct access system to physiotherapy in Austria. Results from this thesis highlighted that further in-depth evaluation within this field of study will be necessary. Results of this thesis also opened opportunities for future research. These recommendations will be discussed in the next chapter.

The current thesis was exclusively done in the context of musculoskeletal medicine. It is acknowledged that other medical fields (e.g. paediatrics, neurology) might require other skills and distinct screening approaches in order to make accurate keep/refer decisions.

Working in a direct access setting is a highly responsible position which warrants the development of a curriculum that teaches physiotherapy students how to recognise the presence of serious pathologies which are not suitable for physiotherapy intervention and require a medical referral. Additionally, before working in a direct access setting, physiotherapists and physiotherapy students need to prove that they possess the necessary knowledge and differential diagnostic skills which ensure the patients' safety.

As a consequence, the ambition of the Austrian physiotherapy association for more practice autonomy requires a fundamental shift how Austrian physiotherapy students are being educated during the undergraduate degree in its current format. This thesis has demonstrated the need for more training and a heightened focus during clinical placements on how to make accurate keep/refer decisions and recognise the presence of serious pathologies. The thesis findings have also highlighted that all educational strategies which aim to teach students how to make accurate keep/refer decisions and recognise serious pathologies need to be tested for their efficacy/effectiveness. It is of course acknowledged that there will always be challenges for curriculum design in applied health sciences as it cannot be possible to continue to add new taught modules to exhaustively cover all diseases in equal depth. However, it is essential to equip future practitioners with highly developed critical thinking skills and strategic awareness of

their professional responsibilities for ensuring patient safety and excellence in clinical care.

Chapter Nine

Recommendations for future research and education

9.1. Introduction

The results of this thesis are important as they have highlighted the gap between the ambitions of the Austrian physiotherapy association to gain practice autonomy (Baumgartner, 2013; Bauer-Horvath, 2015; Sorge, 2017) and the current educational level of Austrian undergraduate physiotherapy students. This thesis then goes on to present some ideas that will form the initial steps towards the development and implementation of a curriculum that will properly equip Austrian physiotherapy students with the necessary skills and knowledge to detect serious pathologies with a patient's clinical presentation.

The recommendations for future research and education will be outlined within the following sections:

9.2. Recommendations for addressing the existing deficiencies in current undergraduate training in Austria to recognise serious pathologies.

- Results from chapter five demonstrated that students from the Netherlands gained the highest score for accuracy on the vignettes from the medical critical category. It would be worthwhile exploring which specific teaching methods and contents are used during the undergraduate education in the Netherlands to teach students how to recognise serious pathologies. This could be done by surveying or interviewing lecturers who are teaching red flag screening from Universities in the Netherlands
- Results from chapter five indicated that more focus needs to be put on assessing patients for the presence of red flags during clinical placements. In addition, clinical supervisors need to make sure that the results from the red flag screening are properly documented by the students during clinical placements (either electronically or paper-based). In this context, it should be mandatory for clinical supervisors to attend regular courses/workshops covering the latest research on red flag screening and recognition of serious pathologies which require a medical referral. To ensure uniformity of course contents, such courses/workshops should be standardized and provided by Austrian

Universities on a regular basis. To ensure participants' compliance, it might also be worthwhile to conduct spot check audits.

- Students in chapter seven also highlighted their lack of experience which makes it difficult for them to accurately detect the presence of serious pathologies. A lack of clinical experience will always be a major limitation during a three year undergraduate degree. However, to ensure ongoing postgraduate education, universities in Austria could provide regular workshops/courses covering the latest research on red flag screening and recognition of serious pathologies together with clinical supervision. Especially in light of an ongoing effort from the Austrian physiotherapy association to implement a direct access system to physiotherapy in Austria, such courses/workshops together with clinical supervision should be made mandatory for qualified physiotherapists. To ensure participants' compliance, spot check audits need to be conducted.

- It was outside the scope of this thesis to evaluate which clinical examination techniques are already routinely taught during the Austrian undergraduate curriculum in different educational institutions. It became clear from chapter six that responding physicians expect Austrian physiotherapists to know several clinical examination procedures. Results of these examination procedures are also important for giving feedback to physicians. Efforts need to be undertaken to set up nation-wide standards as to which clinical examination procedures need to be mandatorily included into the undergraduate curriculum. Moreover, knowledge of these examination procedures need to be assessed both theoretically and practically. [A consultation with the head of the undergraduate physiotherapy programme at the University of Applied Sciences in Krems revealed that the following examination techniques are already taught during the undergraduate physiotherapy degree at the University of Applied Sciences in Krems: Neurological examination of the lower and upper limbs, palpation of peripheral pulses, palpation of organs and blood pressure/temperature/pulses/oxygen saturation. Examination procedures which are currently not taught as part of the undergraduate physiotherapy degree are: Palpation of lymph nodes, examination of cranial nerves and the kidney percussion test].

● Chapter six only included general practitioners and orthopaedic surgeons working in private practice in Austria. Future similar studies should cover experts from other medical fields (e.g. neurology, internal medicine, emergency medicine, gynaecology, cardiology, oncology, rheumatology). Future similar studies might also refrain from using a pre-specified list of suggested clinical examination techniques. Instead, future research might ask open ended questions, such as: ‘which clinical examination techniques do you believe should every qualified physiotherapist be capable of and therefore need to be included into the undergraduate curriculum (and please state why)?’ As an alternative to conventional questionnaires, a consensus methodology such as a Delphi survey might be carried out among various experts from different medical fields as this was done in a doctoral thesis in the United Kingdom by Suckley (2012). Alternatively, future studies might choose to conduct interviews or focus groups with several medical specialists (e.g. orthopaedic surgeons, general practitioners, oncologists, radiologists, rheumatologists).

● Student physiotherapists need to be prepared for the challenges of an aging population. In chapter seven, participating students highlighted difficulties when assessing more complex, multi-morbid patients. Physiotherapy students and qualified physiotherapists need to be able to estimate the need for more in-depth assessment of various organ systems and/or medical referral in complex, comorbid patients. A standardised 23-item screening instrument has shown promising results in assisting clinicians with the identification of signs and symptoms potentially indicating a pathological involvement of one of the major body system (urogenital, pulmonary, cardiovascular, gastrointestinal, endocrine, nervous, integumentary and musculoskeletal) (George et al., 2015).

● The results from chapter five and seven generally suggest that the educational efforts for teaching Austrian undergraduate physiotherapy students how to make sound keep/refer decisions need to be intensified, especially in the light of the desired increased practice autonomy. Results of chapter five and seven make it clear that current teaching efforts are insufficient to prepare undergraduate physiotherapy students to make accurate keep/refer decisions and detect serious pathologies based on clinical vignettes. It appears that there is also the urgent need for more teaching about

pathology (internal medicine and oncology in particular) however, always with special relevance for the physiotherapy profession. The crucial question for the development of the future undergraduate physiotherapy curriculum will be: How much lecturing time are individual physiotherapy departments prepared to spend on red flags screening and on keep/refer decision making?

- In line with the previous comment, future research will need to survey lecturing staff and those responsible for designing the Austrian undergraduate physiotherapy curriculum. It is critical to gain insight into their opinion on how much additional course content and lecturing time spent on red flag screening can be added to an already crowded curriculum.
- It is acknowledged that the patient's voice already plays an important role for planning undergraduate physiotherapy curricula in the United Kingdom. Especially in the context of increased practice autonomy for Austrian physiotherapists, future research should aim at including the patient's voice/perspective as they are eventually the health care consumers. Including the patients' perspective/opinion might also be critical for moving the discussion/agenda of increased practice autonomy for Austrian physiotherapists forward.

9.3. Recommendations for future testing improved undergraduate training to recognise serious pathologies.

- The acceptability of the CBL educational intervention from the perspective of students from the intervention group in chapter seven has been assessed using quantitative research methods (closed-ended questions). This has been conducted in order to be able to collect data from a potentially large number of study participants. It is acknowledged that the data set obtained from closed-ended questions is not as rich as when using qualitative research methods. Shanyinde et al. (2011) point out that '... greater depth of understanding of the acceptability of interventions is obtained from qualitative research' (Shanyinde et al., 2011:8). Hence, it might also be worthwhile to conduct feasibility studies (Eldridge et al., 2016) with less study participants to get more

in-depth information about the acceptability of similar educational interventions (e.g. through semi-structured interviews or focus groups).

- Before the progression towards a definitive RCT can be recommended, future studies need to find the optimal amount of teaching hours needed to improve the keep/refer decision making competencies and recognitions rates of serious pathologies of undergraduate physiotherapy students in Austria. Results from chapter seven suggest that considerably more contact and teaching hours over a longer period of time (e.g. over the course of a semester) are needed. It is therefore advisable to remain in the pre-RCT (exploratory) phase which will ‘... permit testing of alternative forms (‘doses’) of an intervention’ (MRC, 2000:4). To ensure feasibility, such studies might be conducted with fewer students than in the current study.

- The CBL format is generally supported by the literature and is perceived as an effective teaching and learning method for educating health professionals including physiotherapy students (McGinty, 2000; Tärnvik, 2007; Srinivasan et al., 2007; Nelson, 2010; Lowe, 2011; Thistlethwaite et al., 2012). This is supported by the results from chapter seven where students also overwhelmingly enjoyed the case discussions. Yet, it remains unclear which teaching method produces the better clinicians (Thistlethwaite et al., 2012) as this is partly determined by individual learning styles and it is unlikely that a one size fits all approach will be successful. Consequently, instead of using a control group, future studies might compare different teaching approaches/methods (lecture based versus PBL versus CBL).

- Even though RCTs are considered by some authors as the gold standard for evaluating the efficacy/effectiveness of educational interventions (Torgerson, 2002; Goldacre, 2013), others have questioned the usefulness of RCTs to assess the efficacy/effectiveness of educational interventions (Prideaux, 2002; Norman, 2003; Sullivan, 2011; Rowe and Oltmann, 2016). While randomisation is a valuable method against allocation bias (Sullivan, 2011), it has been argued that ‘... randomisation does not control for other sources of variations and confounding factors that are likely to be found in educational contexts’ (Rowe and Oltman, 2016:7). Examples of potential confounders that cannot be eliminated by randomisation are non-interventional learning experiences over the course of the whole study period (e.g. during clinical

placements or in other classes) (Norman 2003) and the inability to completely blind the study participants as they will still be together in other classes (Sullivan, 2011). The inability of blinding might potentially lead to '... contamination effects ...' (Sullivan, 2011:285) as study participants from different experimental groups might interact with each other and exchange the acquired knowledge and different learning experiences (Sullivan, 2011). Moreover, within the MRC framework (2000), the issue of potential preferences of those who receive or provide the intervention is highlighted. The Medical Research Council (2000:15) concludes:

If either the patient [or student] of the provider has a treatment preference, and believe they have received their preferred intervention, they are likely to expect - and therefore achieve - more positive outcomes; where relevant, compliance is likely to be improved. Similarly, if either the patient or provider becomes convinced they did not receive the intervention of choice, outcomes may suffer commensurably.

In this context, the Medical Research Council (2000:16) advocates, as an alternative to a traditional RCT, the:

... preference trial in which those patients [or study participants] with no preferences are randomised as usual but those with preferences and refusing randomisation receive their preferred treatment.

Another alternative to a traditional RCT for assessing the efficacy/effectiveness of educational interventions was proposed by Carney et al. (2004). Carney et al. (2004) recommended the use of longitudinal studies combined with '... repeated cross-sectional methods to measure change over time' (Sullivan, 2011:286). To overcome the limitation of a missing comparison group in non-experimental research, Sullivan (2011) proposed the use of either a historical or a concurrent control group(s). In the context of keep/refer decision making of undergraduate physiotherapy students, the results of chapter five and seven of this thesis or the research paper by Klein et al. (2018) could serve as historical controls. On the other hand, Austrian universities that do not apply the new educational method/approach under investigation could offer themselves as concurrent controls.

- Some students from the intervention group in chapter seven also commented on the fact that the current CBL educational intervention was mainly focused on detecting serious pathologies affecting the spine. Due to the high prevalence of spinal pain within the general population (GBD 2016 Collaborators, 2017), there is an ongoing trend within the current literature to primarily develop strategies which help to identify/exclude severe conditions affecting the vertebral column. Yet, future similar studies should also incorporate best current available evidence to accurately detect/rule out the presence of non-spinal related medical conditions which require medical attention (e.g. fractures of the foot/ankle, fractures of the knee, deep venous thrombosis of the lower limb).

- The limitations of clinical vignettes as a sole instrument for examining decision making strategies of health care professionals have already been highlighted by several authors (Veloski et al., 2005; Mohan et al., 2014; Brunner et al., 2015). Prospective studies need to additionally use standardised or simulated patients as done by Johnston (2018) (e.g. during clinical placements or during classes). This would ensure that the keep/refer decision making competencies and the recognition rates of serious pathologies of Austrian undergraduate physiotherapy students are also assessed in a more clinically related setting.

- When using clinical vignettes, future studies might consider using different answer options. Riddle et al. (2005), for example, asked participating physiotherapists two questions: Firstly, if a patient, in their opinion, had a low, medium, or high risk of suffering from a more grave medical pathology. Secondly, responding physiotherapists should comment on whether they would ‘... contact the referring physician today about this patient’s condition’ (Riddle et al., 2004:721). Another possibility could be to give only two answer options: keep or refer. In addition to that, prospective participants could be asked to comment on if, in the case of choosing to refer the patient, the referral would be urgent or non-urgent (Johnston, 2018). This will enable to test the students’ ability to recognise signs and symptoms of medical conditions where the delay of a timely referral and prompt medical attention might have detrimental effects for a patient health (e.g. in the case of a cauda equina syndrome).

References

- Ahad, A., Elsayed, M. and Tohid, H. (2015) 'The accuracy of clinical symptoms in detecting cauda equina syndrome in patients undergoing acute MRI of the spine.' *The Neuroradiology Journal*, 28(4) pp. 438-442.
- Airaksinen, O., Brox, J. I., Cedraschi, C., Hildebrandt, J., Klüber-Moffett, J., Kovacs, F., Mannion, A. F., Reis, S., Staal, J. B., Ursin, H and Zanoli, G. (2006) 'European guidelines for the management of chronic nonspecific low back pain.' *European Spine Journal*, 15 (Suppl. 2) pp.192–300 [Online] [Accessed on 2nd October 2017] DOI 10.1007/s00586-006-1072-1.
- AMERICAN ASSOCIATION FOR PUBLIC OPINION RESEARCH. (2016) '*Standard definitions: Final Dispositions of Case Codes and Outcome Rates of Surveys.*' [Online] [Accessed on 25th October 2017] http://www.aapor.org/AAPOR_Main/media/publications/Standard-Definitions20169theditionfinal.pdf
- Babyar, S. R., Rosen, E., Sliwinski, M. M., Krasilovsky, G., Holland, T. and Lipovac, M. (2003) 'Physical Therapy Students' self reports of development of clinical reasoning: a preliminary study.' *Journal of Allied Health*, 32(4) pp. 227-239.
- Bachmann, L., Kolb, E., Koller, M. T., Steurer, J. and ter Riet, G. (2003) 'Accuracy of Ottawa ankle rules to exclude fractures of the ankle and mid-foot: a systematic review.' *BMJ*, 326:417, pp. 1-7. [Online] [Accessed on 3rd April 2016] DOI: <https://doi.org/10.1136/bmj.326.7386.417>.
- Baker, S. R., Rabin, A., Lantos, G. and Gallagher, E. J. (1987) 'The effect of restricting the indications of lumbosacral spine radiography in patients with acute back symptoms.' *American Journal of Roentgenology*, 149(3) pp. 535-538.

Balasubramanian, K., Kalsi, P., Greenough, C. G. and Kuskoor Seetharam, M. P. (2010) 'Reliability of clinical assessment in diagnosing cauda equina syndrome.' *British Journal of Neurosurgery*, 24(4) pp. 383-386.

Bardin, L. D., King, P. and Maher, C. G. (2017) 'Diagnostic triage for low back pain: a practical approach for primary care.' *The Medical journal of Australia*, 206(6) pp. 268-273.

Baumgartner, B. (2013) 'Wegweiser für MTD Berufe. (Guide for MTD professions).' *Inform*, 1 p. 12.

Bauer-Horvath, H. (2015) *Zugang zur Physiotherapie – Ein Vergleich zwischen Kanada und Österreich*. (Access to physiotherapy – A comparison between Canada and Austria). Unkown place of publication: Unknown publisher. [Online] [Accessed on 28th November 2015] <https://people.fh-burgenland.at/bitstream/20.500.11790/67/2/Zugang%20zur%20Physiotherapie.pdf>

Beaton, D. E., Bombardier, C., Guillemin, F. and Ferraz, M. B. (2000) 'Guidelines for the Process of Cross-Cultural Adaption of Self-Report Measures.' *Spine*, 25(24) pp. 3186-3191.

Bell, D. A., Collie, D. and Statham, P. F. (2007) 'Cauda equina syndrome: what is the correlation between clinical assessment and MRI scanning?' *British Journal of Neurosurgery*, 21(2) pp. 201-203.

Berk, M. L. (1985) 'Interviewing Physicians: The Effect of Improved Response Rate.' *American Journal of Public Health*, 75(11) pp. 1338-1340.

Beyerlein, C. (2010) *Direktzugang in der Physiotherapie – Wie entscheiden sich Physiotherapeuten im Management ihrer Patienten.* (Direct access in physiotherapy - How physiotherapists decide in the management of their patients). Doktorat der Humanbiologie. Universitätsklinikum Ulm.

Bigos, S., Bowyer, O., Braen, G., Brown, K. C., Deyo, R. A., Haldeman, S., Hart, J. L., Johnsn, E. W., Keller, R. B., Kido, D. K., Liang, M. H., Nelson, R. M., Nordin, M., Owen, B. D., Pope, M. H., Schwartz, R. K., Stewart Jr, D. H., Susman, J L., Triano, J. J., Tripp, L., Turk, D., Watts, C. and Weinstein, J. (1994). *Acute low back pain problems in adults: assessment and treatment: clinical practice guideline No. 14. AHCPR Publication No. 95.* Rockville, MD: US Department of Health and Human Services Public Health Service Agency for Health Care Policy and Research. [Online] [Accessed on 2nd April 2018] <https://pdfs.semanticscholar.org/789f/55c54947db90ac63c496f98226591be7b26d.pdf>

Bjertnaes, O. A., Garratt, A. and Botten, G. (2008) 'Nonresponse Bias and Cost-Effectiveness in a Norwegian Survey of Family Physicians.' *Evaluation & Health Professions*, 31(1) pp. 65-80.

Boissonnault, W. G. (1995) *Examination In Physical Therapy Practice: Screening for Medical Disease.* 2nd ed., New York: Churchill Livingstone Inc.

Boissonnault, W. G. (2011) *Primary Care for the Physical Therapists: Examination and Triage.* 2nd ed., St. Louis: Elsevier Saunders.

Boissonnault, W. G. and Bass, C. (1990) 'Pathological Origins of Trunk and Neck Pain: Part I – Pelvic and Abdominal Visceral Disorders.' *Journal of Orthopaedic & Sports Physical Therapy*, 12(5) pp. 192-207.

Boissonnault, W. G. and Bass, C. (1990) 'Pathological Origins of Trunk and Neck Pain: Part II – Disorders of the Cardiovascular and Pulmonary Systems.' *Journal of Orthopaedic & Sports Physical Therapy*, 12(5) pp. 208-215.

Boissonnault, W. G. and Bass, C. (1990) 'Pathological Origins of Trunk and Neck Pain: Part III – Diseases of the Musculoskeletal System.' *Journal of Orthopaedic & Sports Physical Therapy*, 12(5) pp. 216-221.

Boissonnault, W. G. and Bass, C. (1991) 'Medical Screening Examination: Not Optional for Physical Therapists.' *Journal of Orthopaedic and Sports Physical Therapy*, 14(6) pp. 241-242.

Boissonnault, W. G. and Ross, M. D. (2012) 'Physical therapists referring patients to physicians: a review of case reports and series.' *Journal of Orthopaedic & Sports Physical Therapy*, 42(5) pp. 446-454.

Boissonnault, W., Morgan, B. and Buelow, J. (2006) 'A Comparison of Two Strategies for Teaching Medical Screening and Patient Referral In a Physical Therapist Professional Degree Program.' *Journal of Physical Therapy Education*, 20(1) pp. 28-36.

Bornhöft, L., Thorn, J., Svensson, M., Nordeman, L., Eggertsen, R., Larsson, M. E. H. (2019) 'More cost-effective management of patients with musculoskeletal disorders in primary care after direct triaging to physiotherapists for initial assessment compared to initial general practitioner assessment.' *BMC Musculoskeletal Disorders*, 20(1) pp. 1-9 [Online] [Accessed on 2nd September 2019] Doi: 10.1186/s12891-019-2553-9

Bostock, N. (2016) *GP workload reduced as patients visit practice-based NHS physios*. 4th November. GP online [Online] [Accessed on 4th May 2019]
<https://www.gponline.com/gp-workload-reduced-patients-visit-practice-based-nhs-physios/musculoskeletal-disorders/article/1414548>

Brukner, P. and Khan, K. (2009) *Clinical Sports Medicine*. Revised 3rd ed., North Ryde NSW: The McGraw-Hill Companies.

- Brunner, E., Probst, M., Meichtry, A., Luomajoki, H. and Dankaerts, W. (2015) 'Comparison of clinical vignettes and standardized patients as measures of physiotherapists' activity and work recommendations in patients with non-specific low back pain.' *Clinical Rehabilitation*, 30(1) pp. 85-94.
- Bryman, A. (2006) 'Integrating quantitative and qualitative research: how is it done?' *Qualitative Research*, 6(1) pp. 97-113.
- Bugge, C., Williams, B., Hagen, S., Logan, S., Glazener, C., Pringle, S. and Sinclair, L. (2013) 'A process for Decision-making after Pilot and feasibility Trials (ADePT): development following a feasibility study of a complex intervention for pelvic organ prolapse.' *Trials*, 14:353 pp. 1-13 [Online] [Accessed on 2nd July 2018] Doi: 10.1186/1745-6215-14-353.
- Carney, P. A., Nierenberg, D. W., Pipas, C. F., Brooks, W. B., Stukel, T. A. and Keller, A. M. (2004) 'Educational epidemiology: applying population-based design and analytic approaches to study medical education.' *JAMA*, 292(9) pp. 1044-1050.
- Chandra, K., Atkinson, P. R., Fraser, J., Chatur, H. and Adams, C. (2017) 'MP31: The contrarian effect: how does a Choosing Wisely focused knowledge translation initiative affect emergency physician practice in a high awareness- low investigation environment?' *Canadian Journal of Emergency Medicine*, 19(Supplement 1) pp. S75-S76.
- Charlson, M. E., Pompei, P., Ales, K. L. and MacKenzie, C. R. (1987) 'A new method of classifying prognostic comorbidity in longitudinal studies: development and validation.' *Journal of chronic diseases*, 40(5) pp. 373-383.
- Chen, L., Kim, P. D., Ahmad, C. S. and Levine, W. N. (2008) 'Medial collateral ligament injuries of the knee: current treatment concepts.' *Current Reviews in Musculoskeletal Medicine*, 1(2) pp. 108-113.
- Childs, J. D. and Cleland, J. A. (2006) 'Development and Application of Clinical Decision Rules to Improve Decision Making in Physical Therapy Practice.' *Physical Therapy*, 86(1) pp. 122-131.

Childs, J. D., Whitman, J. M., Sizer, P. S., Pugia, M. L., Flynn, T. W. and Delitto, A. (2005) 'A description of physical therapists' knowledge in managing musculoskeletal conditions.' *BMC Musculoskeletal Disorders*, 6:32, pp.1-7 [Online] [Accessed on 18th July 2016] DOI: 10.1186/1471-2474-6-32.

Clark, D. E. (2007) *SCREENING FOR MEDICAL REFERRAL: ATTITUDES, BELIEFS, AND BEHAVIORS OF PHYSICAL THERAPISTS WITH GREATER THEN 10 YEARS EXPERIENCE*. Doctor of Science. University of Alabama.

Constans, J., Nelzy, M. L., Salmi, L. R., Skopinski, S., Saby, J. C., Le Metayer, P., Moriat, P. and Conri, C. (2011) 'Clinical prediction of lower limb deep vein thrombosis in symptomatic hospitalized patients.' *Thrombosis and Haemostasis*, 86(4) pp. 985-990.

Converse, L., Barrett, K., Rich, E. and Reschovsky, J. (2015) 'Methods of Observing Variations in Physicians' Decisions: The Opportunities of Clinical Vignettes.' *Journal of General Internal Medicine*, 30(Suppl 3) pp. 586-594. [Online] [Accessed on 17th January 2017] DOI: [10.1007/s11606-015-3365-8](https://doi.org/10.1007/s11606-015-3365-8).

Cook, A. M., Lau, T. N., Tomlinson, M. J., Vaidya, M., Wakeley, C. J. and Goddard P. (1998) 'Magnetic Resonance Imaging of the Whole Spine in Suspected Malignant Spinal Cord Compression: Impact on Management.' *Clinical Oncology*, 10(1) pp. 39-43.

Cook, C., Ross, M. D., Isaacs, R. and Hegedus, E. (2012) 'Investigations of Nonmechanical Findings during Spinal Movement Screening for Identifying and/or Ruling out Metastatic Cancer.' *Pain Practice*, 12(6) pp. 426-433.

Cook, C. E., George, S. Z. and Reiman, M. P. (2017) 'Red flag screening for low back pain: nothing to see here, move along: a narrative review.' *British Journal of Sports Medicine*. [Online] 'Published Online First' published 18th September 2017. [Accessed on 19th September 2017] Doi:10.1136/bjsports-2017-098352

Cooney, F., Graham, C., Jeffrey, S. and Hellawell, M. (2017) 'Documentation of spinal red flags during physiotherapy assessment.' *British Journal of Healthcare Management*, 23(12) [Online] [Accessed on 4th August 2018]
<https://doi.org/10.12968/bjhc.2017.23.12.574>

Cottle, L. and Riordan, T. (2008) 'Infectious spondylodiscitis. Review.' *Journal of Infection*, 56(6) pp. 401-412.

Craig, P., Dieppe, P., Macintyre, S., Michie, S., Nazareth, I. and Petticrew, M. (2008) 'Developing and evaluating complex interventions: the New Medical Research Council guidance.' *BMJ*, 337: a1655 [Online] [Accessed on 3rd January 2018]
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2769032/>

Creswell, J. W. (2006) *CHOOSING A MIXED METHODS DESIGN*. Unknown place of publication: Unknown publisher. [Online] [Accessed 20th October 2018]
https://www.sagepub.com/sites/default/files/upm-binaries/10982_Chapter_4.pdf

Cross, P. S., Karges, J. R., Salsbery, M. A., Smith, D. and Stanley, E. J. (2011) 'MANAGEMENT OF ACUTE SPORTS INJURIES AND MEDICAL CONDITIONS BY PHYSICAL THERAPISTS: ASESSMENT VIA CASE SCENARIOS.' *The International Journal of Sports Physical Therapy*, 6(3) pp. 158-172.

Davenport, T. E., Watts, H. G., Kulig, K. and Resnik, C. (2005) 'Current Status and Correlates of Physicians' Referral Diagnoses for Physical Therapy.' *Journal of Orthopaedic and Sports Physical Therapy*, 35(9) pp. 572-579.

David, T. J., Dolmans, D. HJM., Patel, L. and van der Vleuten, CPM. (1998) 'Problem-based learning as an alternative to lecture-based continuing medical education.' *Journal of the Royal Society of Medicine*, 91, December, pp. 626-630.

Denninger, T. R., Cook, C. E., Chapman, C. G., McHenry, T. and Thigpen, C. A. (2018) 'The Influence of Patient Choice of First Provider on Costs and Outcomes: Analysis From a Physical Therapy Patient Registry.' *Journal of Orthopaedic and Sports Physical Therapy*, 48(2) pp. 63-71.

Department of Health. (2006) *The Musculoskeletal Service Framework. A Joint responsibility: doing it differently*. Leeds: DH Publications. [Online] [Accessed 19th July 2018]
http://webarchive.nationalarchives.gov.uk/20130124073659/http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/documents/digitalasset/dh_4138412.pdf

Deyle, G. D. (2006) 'Direct Access Physical Therapy and Diagnostic Responsibility: The Risk-to-Benefit Ratio'. *Physical Therapy*, 36(9) pp. 632-634.

Deyo, R. A. and Diehl, A. K. (1988) 'Cancer as a cause of back pain: frequency, clinical presentation, and diagnostic strategies.' *Journal of general internal medicine*, 3(3) pp. 230-238.

Deyo, R. A., Jarvik, J. G. and Chou R. (2014) 'Low back pain in primary care.' *BMJ*, (349:g4266) July, pp. 1-6 DOI: 10.1136/bmj.g4266.

De Schepper, E. I. T., Koes, B. W., Veldhuizen, E. F. H., Oei, E. H. G., Bierma-Zeinstra, S. M. A. and Luijsterburg, P. A. J. (2016) 'Prevalence of spinal pathology in patients presenting for lumbar MRI as referred from general practice.' *Family Practice*, 33(1) pp. 51-56.

Desmeules, F., Roy, J. S., MacDermid, J. C., Champagne, F., Hinse, O. and Woodhouse, L. J. (2012) 'Advanced practice physiotherapy in patients with musculoskeletal disorders: a systematic review.' *BMC musculoskeletal disorders*, 13:107, pp. 1-21 [Online] [Accessed on 13th August 2016] DOI: 10.1186/1471-2474-13-107.

Diamond, I. R., Grant, R. C., Feldman, B. M., Pencharz, P. B., Ling, S. C., Moore, A. M. and Wales, P. W. (2014) 'Defining consensus: a systematic review recommends methodologic criteria for reporting of Delphi studies.' *Journal of Clinical Epidemiology*, 67(4) pp. 401-409.

Dionne, N., Adefolarin, A., Kunzelman, D., Trehan, N., Finucance, L., Levesque, L., Walton, D. M., Sadi, J. (2019) 'What is the diagnostic accuracy of red flags related to cauda equina syndrome (CES), when compared to Magnetic Resonance Imaging (MRI)? A systematic review.' *Musculoskeletal Science & Practice*, 42, July, pp. 125-133.

Dochy, F., Segers, M., van den Bossche, P. and Gijbels, D. (2003) 'Effects of problem-based learning: a meta-analysis.' *Learning and Instruction*, 13(5) pp. 533-568.

Domen, P. M., Hofman, P. A., van Santbrink, H. and Weber, W. E. J. (2009) 'Predictive value of clinical characteristics in patients with suspected cauda equina syndrome.' *European Journal of Neurology*, 16(3) pp. 416-419.

Donato, E. B., DuVall, R. E., Godges, J. J., Zimmerman, G. J. and Greathouse, D.G. (2004) 'Practice Analysis: Defining the Clinical Practice of Primary Contact Physical Therapy.' *Journal of Orthopaedic & Sports Physical Therapy*, 34(6) pp. 284-304.

Downie, A., Williams, C. M., Henschke, N., Hancock, M. J., Ostelo, R. W. J. G., de Vet, H. C. W., Macaskill, P., Irwig, L., van Tulder, M. W., Koes, B. W. and Maher, C. G. (2013) 'Red Flags to screen for malignancy and fracture in patients with low back pain: systematic review.' *BMJ*, 347:f7095, pp. 1-9. [Online] [Accessed on 13th August 2015] DOI: 10.1136/bmj.f7095.

Downie, F., McRitchie, C., Monteith, W. and Turner, H. (2019) 'Physiotherapists as an alternative to a GP for musculoskeletal conditions: a 2-year service evaluation of UK primary care data.' *British Journal of General Practice*, 69(682) pp. e314-e320.

Dwivedi, S., Banode, P., Gharde, P., Bhatt, M. and Johrapurkar, S. R. (2010) 'Treating traumatic injuries of the diaphragm.' *Journal of Emergencies, Trauma, and Shock*, 3(2) pp. 173-176.

- Dykema, J., Stevenson, J., Day, B., Sellers, S. L. and Bonham, V. L. (2011) 'Effects of Incentives and Prenotifications on Response Rates and Costs in a National Web Survey of Physicians.' *Evaluations & the Health Professions*, 34(4) pp. 434-447.
- Eckler, U., Purrer-Gödl, B., Hurkmans, E., Igelsböck, E. and Wiederin, C. (2017) *Die Physiotherapeutin/der Physiotherapeut - Kompetenzprofil*. (The physiotherapist - competence profile). 2nd edition., Vienna: Physio Austria. [Online] [Accessed 20th July 2017]
https://www.physioaustria.at/system/files/general/phy_kompetenzprofil_deutsch_fin_072017.pdf
- Eldridge, S. M., Lancaster, G. A., Campbell, M. J., Thabane, L., Hopewell, S., Coleman, C. L. and Bond, C. M. (2016) 'Defining Feasibility and Pilot Studies in Preparation for Randomised Controlled Trials: Development of a Conceptual Framework. *PlosOne*, 11(3): e0150205, pp. 1-22 [Online] [Accessed on 15th December 2017]
 Doi:10.1371/journal.pone.0150205.
- Eldridge, S. M., Chan, C. L., Campbell, M. J., Bond, C. M., Hopewell, S., Thabane, L. and Lancaster, G. A., on behalf of the PAFS consensus group. (2016) 'CONSORT 2010 statement: extension to randomised pilot and feasibility trials.' *BMJ*, 355:i5239, pp. 1-29 [Online] [Accessed on 15th December 2017] <http://www.bmj.com/content/bmj/355/bmj.i5239.full.pdf>
- Emparanza, J. I. and Aginaga, J. R. (2001) 'Validation of the Ottawa Knee Rules.' *Annals of Emergency Medicine*, 38(4) pp. 364-368.
- Engelberger, R. P., Aujesky, D., Calanca, L., Staeger, P., Hugli, O. and Mazzolai, L. (2011) 'Comparison of the diagnostic performance of the original and modified Wells score in inpatients and outpatients with suspected vein thrombosis.' *Thrombosis Research*, 127(6) pp. 535-539.
- ENPHE-European Network of Physiotherapy in Higher Education. (2018) *Mission and Vision*. [Online] [Accessed on 4th June 2019] <http://www.enphe.org/mission-and-vision/>

Enthoven, W. T. M., Geuze, J., Scheele, J., Bierma-Zeinstra, S. M. A., Bueving, H. J., Bohnen, A. M., Peul, W. C., van Tulder, M. W., Berger, M. Y., Koes, B. W. and Luijsterburg, P. A. J. (2016) 'Prevalence and „Red Flags“ Regarding Specific Causes of Back Pain in Older Adults Presenting in General Practice.' *Physical Therapy*, 96(3) pp. 305-312.

European Region of World Confederation for Physical Therapy (ER-WCPT). (2008) *European Core Standards of Physiotherapy Practice*. Athens: ER-WCPT.
www.erwcpt.eu/file/86

Evans, S. C., Roberts, M. C., Keeley, J. W., Blossom, J. B., Amaro, C. M., Garcia, A. M., Odar Stough, C., Canter, K. S., Robles, R. and Reed, G. M. (2015) 'Vignette methodologies for studying clinicians' decision making: Validity, utility, and application in ICD-11 field studies.' *International Journal of Clinical and Health Psychology*, 15 pp. 160-170. [Online] [Accessed on 22nd January 2017]
http://www.ccomssantementalelillefrance.org/sites/ccoms.org/files/Evans_vignette%20methodologies_2014.pdf.

Fawkes, C. and Carnes, D. (2012) 'What is the relevance of coloured flags to osteopathic practice?' *The osteopath magazine*, 15(5), pp: 20-22 [Online] [Accessed on 6th December 2016] <http://www.osteopathy.org.uk/news-and-resources/document-library/publications/the-osteopath-octnov-2012/1the-osteopath-octnov-2012.pdf>.

FH-MTD. (2006) *Verordnung der Bundesministerin für Gesundheit und Frauen über Fachhochschul-Bakkalaureatsstudiengänge für die Ausbildung in den gehobenen medizinisch-technischen Diensten (FH-MTD-Ausbildungsverordnung – FH-MTD-AV)*. (Ordinance of the Federal Minister of Health and Women's Affairs on bachelor's degree programmes at universities of applied sciences for training in the higher medical-technical services (FH-MTD Training Ordinance - FH-MTD-AV). Unknown place of publication: Bundesministerium für Digitalisierung und Wirtschaftsstandort. [Online] [Accessed on 27th July 2015]
<https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=20004516>

Finucane, L., Greenhalgh, S. and Selfe, J. (2017) 'What are the Red flags to aid the early detection of metastatic bone disease as a cause of low back pain?' *Physiotherapy Practice and Research*, 38(2) pp. 73-77.

Finucane, L. and Mercer, C. (2019) *NAVIGATING THE CLINICAL MAZE OF RED FLAGS IN THE SPINE*. Geneva: World Confederation of Physical Therapists. 53-page handout, distributed on 10th May 2019 during pre-conference course at the WCPT conference in Geneva 2019.

Flanigan, T. and McFarlane, E. S. (2008) 'Conducting Survey Research Among Physicians and Other Medical Professionals: A Review of Current Literature.' Paper presented at: *The AAPOR Conference*. New Orleans, 15th May.

Foster, N. E., Hartvigsen, J. and Croft, P. R. (2012) 'Taking responsibility for the early assessment and treatment for patients with musculoskeletal pain: a review and critical analysis.' *Arthritis Research & Therapy*, 14(1) pp. 1-9. [Online] [Accessed on 8th July 2012] <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3392833/pdf/ar3743.pdf>

Fraser, S., Roberts, L. and Murphy, E. (2009) 'Cauda Equina Syndrome: A Literature Review of Its Definition and Clinical Presentation.' *Archives of Physical Medicine and Rehabilitation*, 90(11) pp. 1964-1968.

Freedman, K. B. and Bernstein, J. (1998) 'The Adequacy of Medical School Education in Musculoskeletal Medicine.' *The Journal of Bone and Joint Surgery*, 80(10) pp. 1421-1427.

Fritz, J. M. and Wainner, R. S. (2001) 'Examining Diagnostic Tests: An Evidence-Based Perspective.' *Physical Therapy*, 81(9) pp. 1546-1564.

Galliker, G., Scherer, D. E., Trippolini, M. A., Rasmussen-Barr, E., LoMartire, R., Wertli, M. M. (2019) 'Low Back Pain in the Emergency Department: Prevalence of Serious Spinal Pathologies and Diagnostic Accuracy of Red Flags – A Systematic Review.' *The American Journal of Medicine*. [Online] 'First Online' published 3rd July 2019. [Accessed on 14th August 2019] Doi: 10.1016/j.amjmed.2019.06.005.

Garg, R. K. and Somvanshi, D. S. (2011) 'Spinal tuberculosis: a review.' *The journal of spinal cord medicine*, 35(5) pp. 440-454.

GBD 2016 Disease and Injury Incidence and Prevalence Collaborators. (2017) 'Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016.' *The Lancet*, 390(10100) pp.1211-1259.

Geersing, G. J., Zuithoff, N. P. A., Kearon, C., Anderson, D. R., Ten Cate-Hoek, A., Elf, J. L., Bates, S. M., Hoes, A. W., Kraaijenhagen, R. A., Oudega, R., Schutgens, R. E., Stevens, S. M., Woller, S. C., Wells, P. S. and Moons, K. G. (2014) 'Exclusion of deep venous thrombosis using the Wells rule in clinically important subgroups: individual patient meta-analysis.' *BMJ*, 348:g1340, pp. 1-13. [Online] [Accessed on 5th January 2017] DOI: 10.1136/bmj.g1340.

George, S. Z., Beneciuk, J. M., Bialosky, J. E., Lentz, T. A., Zeppieri, G. jr., Pei, Q., Wu, S. S. (2015) 'Development of a Review-of-Systems Screening Tool for Orthopaedic Physical Therapists: Results From the Optimal Screening for Prediction of Referral and Outcome (OSPRO) Cohort.' *Journal of Orthopaedic and Sports Physical Therapy*, 45(7) pp. 512-526.

George, S. Z., Beneciuk, J. M., Lentz, T. A., Wu, S. S., Dai, Y., Bialosky, J. E. and Zeppieri, G. jr. (2018) 'Optimal Screening for Prediction of Referral and Outcome (OSPRO) for Musculoskeletal Pain Conditions: Results from the Validation Cohort.' *Journal of Orthopaedic and Sports Physical Therapy*, 48(6) pp. 460-475.

Germon, T., Ahuja, S., Casey, A. T. H., Todd, N. V. and Rai, A. (2015) 'British Association of Spine Surgeons standards of care for cauda equina syndrome.' *The Spine Journal*, 15(3) pp. 2S-4S.

Gitelman, A., Hishmeh, S., Morelli, B. N., Joseph, S. A., Casden, A., Kuflik, P., Neuwirth, M. and Stephen M. (2008) 'Cauda Equina Syndrome: A Comprehensive Review.' *American Journal of Orthopaedics*, 37(11) pp. 556-562.

Goldacre, B. (2013) *BUILDING EVIDENCE INTO EDUCATION*. Manchester: Department of Education. [Online] [Accessed 5th May 2019]
<http://media.education.gov.uk/assets/files/pdf/b/ben%20goldacre%20paper.pdf>

Goodman, C. C. and Fuller K. S. (2009) *Pathology: Implications for the Physical Therapist*. 3rd ed., St. Louis: Saunders Elsevier.

Goodman, C. C. and Snyder, T. E. K. (2013) '*Differential Diagnosis for Physical Therapists. Screening for Referral*' 5th ed., St.Louis: Saunders Elsevier.

Gray, J. C. (2012) 'Visceral Referred Pain to the Shoulder.' *In* Donatelli, R. A. *Physical Therapy of the Shoulder*. 5th ed., St. Louis, Missouri: Churchill Livingstone, pp. 267-304.

Greenhalgh, S. and Selfe, J. (2003) 'John: a case of malignant myeloma of the spine.' *Physiotherapy*, 89(8) pp. 486-488.

Greenhalgh, S. and Selfe, J. (2009) 'A qualitative investigation of Red Flags for serious spinal pathology.' *Physiotherapy*, 95(3) pp. 223-226.

Greenhalgh, S., Truman, C., Webster, V. and Selfe J. (2015) 'An investigation into the patient experience of Cauda Equina Syndrome: A qualitative study.' *Physiotherapy Practice and Research*, 36(1) pp. 23-31.

Greenhalgh, S., Truman, C., Webster, V. and Selfe J. (2016) 'Development of a toolkit for early identification of cauda equina syndrome.' *Primary Health Care Research & Development*, 17(6) pp. 559-567.

Greenhalgh, S., Finucane, L., Mercer, C. and Selfe, J. (2018) 'Assessment and management of cauda equine syndrome.' *Musculoskeletal Science and Practice*, 37, pp. 69-74. [Online] [Accessed on 3rd October 2018] DOI: 10.1016/j.msksp.2018.06.002.

Grimshaw, J. (2014) 'SURGE (The Survey Reporting GuidelinE).' In Moher, D., Altman, D. G., Schulz, K. F., Simera, I., Wager, E. (ed.) *Guidelines for Reporting Health Research: A User's Manual*. Oxford, UK: John Wiley & Sons, Ltd, pp. 206-213.

Groll, D. L., To, T., Bombardier, C. and Wright, J. G. (2005) 'The development of a comorbidity index with physical function as the outcome.' *Journal of Clinical Epidemiology*, 58(6) pp. 595-602.

Grunau, G. L., Darlow, B., Flynn, T., O'Sullivan, K., O'Sullivan, P. B. and Forster, B. B. (2018) 'Red flags or red herrings? Redefining the role of red flags in low back pain to reduce over imaging.' *British Journal of Sports Medicine*, 52(8) pp. 488-489
<http://dx.doi.org/10.1136/bjsports-2017-097725><http://dx.doi.org/10.1136/bjsports-2017-097725>.

Halcomb, E. and Hickman, L. (2015) *Mixed methods research. Nursing standard: promoting excellence in nursing care*. Wollongong: Faculty of Science, Medicine and Health. [Online] [Accessed on 4th December 2018]
<https://ro.uow.edu.au/cgi/viewcontent.cgi?article=3676&context=smhpapers>

Heick, J.D., Boissonault, W. G. and King, P. M. (2013) 'Physical Therapist recognition of signs and symptoms of infection after shoulder surgery: a patient case report.' *Physiotherapy Theory and Practice*, 29(2) pp. 166-173.

Heit, J. A. (2006) 'The Epidemiology of Venous Thromboembolism in the Community: Implications for Prevention and Management.' *Journal of Thrombosis and Thrombolysis*, 21(1) pp. 23-29.

Henschke, N., Maher, C. G. and Refshauge, K. M. (2007) 'Screening for malignancy in low back pain patients: a systematic review.' *European Spine Journal*, 16(10) pp. 1673-1679.

Henschke, N., Maher, C. G. and Refshauge, K. M. (2008) 'A systematic review identifies five "red flags" to screen for vertebral fracture in patients with low back pain.' *Journal of Clinical Epidemiology*, 61(2) pp. 110-118.

Henschke, N., Maher, C. G., Refshauge, K. M., Herbert, R. D., Cumming, R. G., Bleasel, J., York, J., Das, A. and McAuley, J. H. (2009) 'Prevalence of and Screening for Serious Spinal Pathology in Patients Presenting to Primary Spine Settings With Acute Low Back Pain.' *Arthritis & Rheumatism*, 60(10) pp. 3072-3080.

Henschke, N., Maher, C.G., Ostelo, R. W. J. G., de Vet, H. C. W., Macaskill, P. and Irwig, L. (2013) 'Red Flags to screen for malignancy in patients with low-back pain (Review).' *Cochrane Database of Systematic Reviews*, 2:CD008686, pp. 1-29. [Online] [Accessed on 3rd October 2016] DOI: 10.1002/14651858.CD008686.pub2.

Hsieh, H. F. and Shannon, S. E. (2005) 'Three Approaches to Qualitative Content Analysis.' *Qualitative Health Research*, 15(9) pp. 1277-1288.

IMC Fachhochschule Krems. (2016) *Satzung des Kollegiums*. (Statutes of the College). Publisher details not available. [Online] [Accessed on 2nd June 2018] https://www.fh-krems.ac.at/fileadmin/downloads/user_upload/Satzung_des_Kollegiums_der_IMC_Fachhochschule_Krems.pdf.pdf

James, K. M., Ziegenfuss, J. Y., Tilburt, J. C., Harris, A. M. and Beebe, T. J. (2011) 'Getting Physicians to Respond: The Impact of Incentive Type and Timing on Physician Survey Response Rates.' *Health Service Research*, 46(1 Part 1) pp. 232-242.

Javrik, J. G. and Deyo, R. A. (2002) 'Diagnostic Evaluation of Low Back Pain with Emphasis on Imaging.' *Annals of Internal Medicine*, 137(7) pp. 586-597.

Jette, D. U., Ardleigh, K., Chandler, K. and McShea, L. (2006) 'Decision-Making Ability of Physical Therapists: Physical Therapy Intervention or Medical Referral.' *Physical Therapy*, 86(12) pp. 1619-1629.

Johnson, T. P. and Wislar, J. S. (2012) 'Response Rates and Nonresponse Errors in Surveys.' *JAMA*, 307(17) pp. 1805-1806.

Johnston, T. (2018) 'Assessment of Medical Screening and Clinical Reasoning Skills by Physical Therapy Students in a Simulated Patient Encounter.' *The Internet Journal of Allied Health Sciences and Practice*, 16(2), pp: 1-9 [Online] [Accessed on 8th November 2018] <https://nsuworks.nova.edu/ijahsp/vol16/iss2/10/>

Joines, J. D., McNutt, R. A., Carey, T. S., Deyo, R. A. and Rouhani R. (2001) 'Finding Cancer in Primary Care Outpatients with Low Back Pain.' *Journal of general internal medicine*, 16, January, pp. 14-23.

Jones, M. A. (1992) 'Clinical Reasoning in manual therapy.' *Physical Therapy*, 72(12) pp. 875-884.

Jose, A. and Dal Corso, S. (2016) 'Inpatient rehabilitation improves functional capacity, peripheral muscle strength and quality of life in patients with community-acquired pneumonia: a randomised trial.' *Journal of Physiotherapy*, 62(2) pp. 96-102.

Kahanov, L., Eberman, L. E., Games, K. E. and Wasik, M. (2015) 'Diagnosis, treatment and rehabilitation of stress fractures in the lower extremity in runners.' *Open Access Journal of Sports Medicine*, 6, March, pp. 87-95. [Online] [Accessed on 12th March 2017] DOI: [10.2147/OAJSM.S39512](https://doi.org/10.2147/OAJSM.S39512).

Kanuk, L. and Berenson, C. (1975) 'Mail Surveys and Response Rates: A Literature Review.' *Journal of Marketing Research*, 12(4) pp. 440-453.

Kapsalaki, E., Gatselis, N., Stefos, A., Makaritsis, K., Vassious, A., Fezoulidis, I. and Dalekos, G. N. (2009) 'Spontaneous spondylodiscitis: presentation, risk factors, diagnosis, management, and outcome.' *International Journal of Infectious Diseases*, 13(5) pp. 564-569.

Karges, J. R., Cross, P. S., Hauer, P. L., Blom, H., Burcham, J., Myers, A. K. and Grimsrud, C. (2013) 'EFFECTIVENESS OF THE EMERGENCY RESPONSE COURSE IN IMPROVING STUDENT PHYSICAL THERAPISTS' AND LICENSED PHYSICAL THERAPISTS' DECISION-MAKING REALATED TO ACUTE SPORTS INJURIES AND MEDICAL CONDITIONS.' *The International Journal of Sports Physical Therapy*, 8(3) pp. 277-289.

Kim, D. H. and Vaccaro, A. R. (2006) 'Osteoporotic compression fractures of the spine: current options and considerations for treatment.' *The Spine Journal*, 6(5) pp. 479-487.

Klein, P., Rottler, E. and von Wietersheim, J. (2018) 'Screening in Physiotherapy: Differences in the Skills of Participants of Different Training Courses in Germany and the Netherlands.' *PhysioScience*, 14(4) pp. 170-177.

Knipp, R. (2008) *First Contact Practice für Physiotherapeutinnen. Eine weitere berufspolitische Entwicklung und ein Muss für die Zukunft? Eine Online Umfrage und Analyse unter Physiotherapeutinnen in Österreich.* (First Contact Practice for physiotherapists. Another professional development and a must for the future? An online survey and analysis among physiotherapists in Austria). M.Sc. Danube University Krems.

Knox, G. M., Snodgrass, S. J. and Rivett, DA. (2015) 'Physiotherapy clinical educator's perceptions and experiences of clinical prediction rules.' *Physiotherapy*, 101(4) pp. 364-372.

Knox, G. M., Snodgrass, S. J., Stanton, T. R., Kelly, D. H., Vicenzino, B., Wand, B. M. and Rivett, D. A. (2016) 'Physiotherapy Students' Perceptions And Experiences Of Clinical Prediction Rules.' *Physiotherapy*. [Online] 'First online' published 18th April 2016. [Accessed on 25th April 2016] DOI: <http://dx.doi.org/doi:10.1016/j.physio.2016.04.001>.

Koes, B. W., van Tulder, M. W. and Thomas S. (2006) 'Diagnosis and treatment of low back pain.' *BMJ*, 332(7555) pp. 1430-1434. [Online] [Accessed on 15th October 2016] DOI: [10.1136/bmj.332.7555.1430](https://doi.org/10.1136/bmj.332.7555.1430).

- Koidl, A. (2017) *Direct Access zur Physiotherapie: Sind Salzburgs Bachelor Studierende bereit?* B.Sc. University of Applied Sciences Salzburg.
- Lackenbauer, W. (2018) 'Peripheral Arterial Occlusive Disease Causing Unilateral Pain in Buttock and Thigh: Case Report.' *Manuelle Therapie*, 22, May, pp. 95-99.
- Lackenbauer, W. (2019) 'Coronary Myocardial Disease as Cause of Complaints in the Area of the Thoracic Spine and Sternum: Case Report.' *Manuelle Therapie*, 23, September, pp. 184-189.
- Lackenbauer, W. and Janssen, J. (2016) 'Gallstones as a Source of Muscular Thoracic Pain: Case Report.' *Manuelle Therapie*, 20, December, pp. 235-238.
- Lackenbauer, W. and Janssen J. (2017) 'Lyme Disease as a Source of Chronic Cervical Spine Complaints Radiating into the Upper Extremity: Case Report.' *Manuelle Therapie*, 21, February, pp. 43-46.
- Lackenbauer, W., Janssen, J., Roddam, H. and Selfe, J. (2017) 'Is keep/refer decision making an integral part of national guidelines for the physiotherapy profession within Europe? A review.' *Physiotherapy*, 103(4) pp. 352-360 DOI: <https://doi.org/10.1016/j.physio.2016.11.005>
- Lackenbauer, W., Janssen, J., Roddam, H. and Selfe, J. (2018) 'Keep/refer decision making abilities of European final year undergraduate physiotherapy students: a cross-sectional survey using clinical vignettes.' *European Journal of Physiotherapy*, 20(3) pp. 128-134 <https://doi.org/10.1080/21679169.2017.1408682>.
- Ladeira, C. E. (2018) 'Physical therapy clinical specialisation and management of red and yellow flags in patients with low back pain in the United States.' *Journal of Manual & Manipulative Therapy*, 26(2) pp. 66-77.
- Lavy, C., Wilson-McDonald, J. and Fairbank J. (2009) 'Cauda Equina Syndrome: Clinical Review.' *BMJ*, 338(7699) pp. 881-884. [Online] [Accessed on 20th December 2016] <http://www.jstor.org/stable/20512601>.

Lebec, M. T. and Jogodka, C. E. (2009) 'The Physical Therapist as a Musculoskeletal Specialist in the Emergency Department.' *Journal of Orthopaedic & Sports Physical Therapy*, 93(3), pp. 221-229.

Lee, T. H., Cook, E. F., Weisberg, M., Sargent, R. K., Wilson C. and Goldman, L. (1985) 'Acute chest pain in the emergency room identification and examination of low-risk patients.' *Archives of Internal Medicine*, 145(1) pp. 65-69.

Leemrijse, C. J., Swinkels, I. C. S. and Veenhof, C. (2008) 'Direct Access to Physical Therapy in the Netherlands: Results From the First Year in Community-Based Physical Therapy.' *Physical Therapy*, 88(8) pp. 936-946.

Leerar, P. J., Boissonnault, W., Domholdt, E. and Roddey, T. (2007) 'Documentation of Red Flags by Physical Therapists for Patients with Low Back Pain.' *Journal of Manual & Manipulative Therapy*, 15(1) pp. 42-49.

Levack, P., Graham, J., Collie, D., Grant, R., Kidd, J., Kunkler, I., Gibson, A., Hurman, D., McMillan, N., Rampling, R., Slider, L., Statham, P. and Summer, D. (2002) 'Don't wait for a sensory level—listen to the symptoms: a prospective audit of the delays in diagnosis of malignant spinal cord compression.' *Clinical oncology (Royal College of Radiologists (Great Britain))*, 14(6) pp. 472-480.

Lewis J. S. (2011) 'Subacromial impingement syndrome: a musculoskeletal condition or clinical illusion?' *Physical Therapy Reviews*, 16(5) pp. 388-398.

Liu, H. and Fletcher, J. P. (2006) 'ANALYSIS OF PHYISCIAN'S REFERRALS: IS FURTHER DIAGNOSIS NEEDED?' *NORTH AMERICAN JOURNAL OF SPORTS PHYSICAL THERAPY*, 1(1) pp. 10-15.

Lowe, W. (2011) 'Is the Sun Setting on Lecture-Based Education?' *International Journal of Therapeutic Massage and Bodywork*, 4(4) pp. 7-9.

Mabry, L. M., Ross, M. D. and Tonarelli, J. M. (2014) 'Metastatic cancer mimicking mechanical low back pain: a case report.' *Journal of Manual and Manipulative Therapy*, 22(3) pp. 162-169.

Manikandan, S. (2011) 'Measures of central tendency: Median and mode' *Journal of Pharmacology and Pharmacotherapeutics*, 2(3) pp. 214-215.

Marks, D., Comans, T., Bisset, L. and Scuffham, P. A. (2017) 'Substitution of doctors with physiotherapists in the management of common musculoskeletal disorders: a systematic review.' *Physiotherapy*, 103, pp. 341-351.

Matthews, C. J., Weston, V. C., Jones, A., Field, M. and Coakley, G. (2010) 'Bacterial septic arthritis in adults.' *Lancet*, 375(9717) pp. 846-855.

Matzkin, E., Smith, M. E., Freccero, C. D. and Richardson, A. B. (2005) 'Adequacy of education in musculoskeletal medicine.' *The Journal of Bone and Joint Surgery*, 87(2) pp. 310-314.

McAllister, K., Goodson, N., Warburton, L. and Rogers G. (2017) 'Spondyloarthritis: diagnosis and management: summary of NICE guidance.' *BMJ*, 356:j839, pp. 1-5.
[Online] [Accessed on 3rd March 2017] DOI: 10.1136/bmj.j839.

McFarlane, E., Olmsted, M. G., Murphey, J. and Hill, C. A. (2007) 'Nonresponse Bias in a Mail Survey of Physicians.' *Evaluation & the Health Professions*, 30(2) pp. 170-185.

McGinty, S. M. (2000) 'Case-Method Teaching: An Overview of the Pedagogy and Rational for Its Use in Physical Therapy Education.' *Journal of Physical Therapy Education*, 14(1) pp. 48-51.

McLean, S. F. (2016) 'Case-Based Learning and its Application in Medical and Health-Care Fields: A Review of Worldwide Literature.' *Journal of Medical Education and Curricular Development*, 3: JMECD.S20377, pp. 39-49. [Online] [Accessed on 27th January 2018] Doi: 10.4137/JMECD.S20377.

Medical Research Council (MRC). (2000) *A FRAMEWORK FOR DEVELOPMENT AND EVALUATION OF RCTs FOR COMPLEX INTERVENTION TO IMPROVE HEALTH*. London: Medical Research Council (MRC). [Online] [Accessed on 8th December 2017] <https://mrc.ukri.org/documents/pdf/rcts-for-complex-interventions-to-improve-health/>

Medical Research Council (MRC). (2006) *Developing and evaluating complex interventions: new guidance*. London: Medical Research Council (MRC). [Online] [Accessed on 10th December 2017] <https://www.mrc.ac.uk/documents/pdf/complex-interventions-guidance/>

Min, A., Chan, V. W. Y., Aristizabal, R., Peramlik, E. R., Agulnik, D. B., Styrdom, N., Ramsey, D. and Forster, B. B. (2017) 'Clinical Decision Support Decreases Volume of Imaging for Low Back Pain in an Urban Emergency Department.' *Journal of the American College of Radiology*, 14(7), pp. 889-899. [Online] [Accessed on 16th January 2018] DOI: 10.1016/j.jacr.2017.03.005

Mohan, D., Fischhoff, B., Farris, C., Switzer, G. E., Rosengart, M. R., Yealy, D. M., Saul, M., Angus, D. C. and Barnato, A. E. (2014) 'Validating a Vignette-Based Instrument to Study Physician Decision Making in Trauma Triage.' *Medical Decision Making*, 34(2) pp. 242-252.

Moore, G. F., Audrey, S., Barker, M., Bond, L., Bonell, C., Hardeman, W., Moore, L., O'Cathain, A., Tinati, T., Wight, D. and Baird, J. (2015) 'Process evaluation of complex interventions: Medical Research Council guidance.' *BMJ*, 350:h1258 pp. 1-7 [Online] [Accessed on 3rd January 2018] DOI: 10.1136/bmj.h1258.

Moore, J. H., McMillian, D. J., Rosenthal, M. D. and Weishaar, M. D. (2005) 'Risk Determination for Patients With Direct Access to Physical Therapy in Military Health Care Facilities.' *Journal of Orthopaedic & Sports Physical Therapy*, 35(10) pp. 674-678.

Mount, H. E. (2012) *SCREENING FOR MEDICAL REFERRAL: DETERMINING VARIABLES THAT INFLUENCE ACCURACY*. Doctor of Science. University of Alabama.

National Screening Committee. (1998) '*First Report of the National Screening Committee*.' Unknown place of publication: Health Departments of the United Kingdom. [Online] [Accessed on 15th September 2018]
<http://aogm.org.mo/assets/Uploads/aogm/Guidelines/NHS/National-Screening-Committee-UK-1998.pdf>

Nelson, T. K. (2010) *Case-Based Learning (CBL) in Selected Therapy Curricula and Its Perceived Effectiveness by Students, Faculty, and Administrators*. Doctor of Philosophy. University of New Orleans.

Neufeld, V. R. and Barrows, H. S. (1974) 'The "McMaster Philosophy": an approach to medical education.' *Journal of Medical Education*, 49(11) pp. 1040-1050.

Nicholas, M. K., Linton, S. J., Watson, P. J. and Main, C. J. (2011) 'the "Decade of the Flags" Working Group. Early Identification and Management of Psychological Risk Factors ("Yellow Flags") in Patients with Low Back Pain: A Reappraisal.' *Physical Therapy*, 91(5) pp. 737-753.

Norman, G. (2003) 'RCT=results confounded and trivial: the perils of grand educational experiments.' *Medical education*, 37(7) pp. 582-584

Oikonomou, A. and Prassopoulos, P. (2011) 'CT Imaging of blunt chest trauma.' *Insights Imaging*, 2(3) pp. 281-295.

Ojha, H. A., Snyder, R. S. and Davenport, T. E. (2014) 'Direct access compared with referred physical therapy episodes of care: a systematic review.' *Physical Therapy*, 94(1) pp. 14-30.

Oliver, T. B., Bhat, R., Kellet, C. F. and Adamson, D. J. (2011) 'Diagnosis and management of bone metastases.' *The Journal of the Royal College of Physicians in Edinburgh*, 41(4) pp. 330-338.

Oliviera, A. S., Abbasi, F. and Radha, S. S. (2015) 'A hot, swollen joint without trauma: septic arthritis until proven otherwise.' *BMJ case reports*, pp. 1-2. [Online] [Accessed on 17th of May 2016] DOI:10.1136/bcr-2014-209190.

O'Sullivan P. B. (2005) 'Diagnosis and classification of chronic low back pain disorders: Maladaptive movement and motor control impairments as underlying mechanism.' *Manual Therapy*, 10(4) pp. 242-255.

O'Sullivan, P. B. (2011) 'It's time for change with the management of non-specific chronic low back pain.' *British Journal of Sports Medicine*, 46(4) pp. 224-227.

Peabody, J. W., Luck, J., Glassman, P., Dresselhaus, T. R. and Lee, M. (2000) 'Comparison of Vignettes, Standardized Patients, and Chart Abstraction: A Prospective Validation Study of 3 Methods for Measuring Quality.' *Journal of the American Medical Association*, 283(13) pp. 1715-1722.

Peabody, J. W., Luck, J., Glassman, P., Jain, S., Hansen, J., Spell, M. and Lee, M. (2004) 'Measuring the Quality of Physician Practice by Using Clinical Vignettes: A Prospective Validation Study.' *Annals of Internal Medicine*, 141(10) pp. 771-780.

Phillips, A. C., Lewis, L. K., McEvoy, M. P., Galipeau, J., Glasziou, P., Moher, D., Tilson, J. K. and Williams, M. T. (2016) 'Development and validation of the guideline for reporting evidence-based practice educational interventions and teaching (GREET).' *BMC Medical Education*, 16:237 pp. 1-10 [Online] [Accessed on 6th January 2018] <https://doi.org/10.1186/s12909-016-0759-1>.

Physio Austria. (2004) *Berufsprofil des/der diplomierten Physiotherapeutin/Physiotherapeuten*. (Professional profile of the qualified physiotherapist). Vienna: Physio Austria. [Online] [Accessed on 3rd October 2016] <https://www.physioaustria.at/system/files/general/berufsprofil.pdf>.

Physio Austria. (2014) *PhysiotherapeutInnen in Primary Health Care: best point of service*. Unknown place of publication: Physio Austria. [Online] [Accessed 2nd July 2015] https://www.physioaustria.at/system/files/general/positionspapier_physiotherapeutinnen_in_phc_062014.pdf.

Physio Austria. (2017) *Direktzugang zur Physiotherapie – FAQ: DISKUSSION ÜBER DIE MÖGLICHKEIT EINER ZUKUNFT OHNE VERORDNUNG IN ÖSTERREICH*. (Direct access to Physiotherapy - FAQ: DISCUSSION ABOUT THE POSSIBILITY OF A FUTURE WITHOUT REGULATION IN AUSTRIA). Unknown place of publication: Physio Austria. [Online] [Accessed 3rd June 2018] https://www.physioaustria.at/system/files/general/directaccess-faqs_direktzugang_website_fin_august_2017.pdf

Piano, L., Maselli, F., Viceconti, A., Gianola, S. and Ciuro, A. (2017) 'Direct access to physical therapy for the patient with musculoskeletal disorders, a literature review.' *The Journal of Physical Therapy Science*, 29, pp. 1463-1471.

Piscitelli, D., Furmanek, M. P., Meroni, R., De Caro, W. and Pellicciari, L. (2018) 'Direct access in physical therapy: a systematic review.' *La clinica terapeutica*, 169(5) pp. e249-e260.

Podnar S. (2007) 'EPIDEMIOLOGY OF CAUDA EQUINA AND CONUS MEDULLARIS LESIONS.' *Muscle & Nerve*, 35(4) pp. 529-531.

Portney, J. G. and Watkins, M. P. (2009) *Foundations of clinical research: application to practice*. 3rd ed., New Jersey: Pearson Education.

Premkumar, A., Godfrey, W., Gottschalk, M. B. and Boden, S. D. (2018) 'Red Flags for Low Back Pain Are Not Always Really Red: A Prospective Evaluation of the Clinical Utility of Commonly Used Screening Questions for Low Back Pain.' *The Journal of Bone and Joint Surgery*, 100(5) pp. 368-374.

Prideaux, D. (2002) 'Researching the outcomes of educational interventions: a matter of design.' *BMJ*, 324(7330) pp. 126-127.

- Reito, A., Kyrölä, K., Pekkanen, L. and Palenova, J. (2018) 'Specific spinal pathologies in adult patients with an acute or subacute atraumatic low back pain in the emergency department.' *International Orthopaedics*. [Online] 'First online' published 29th May 2018. [Accessed on 18th July 2018] <https://doi.org/10.1007/s00264-018-3983-y>
- Riddle, L. D., Hillner, B. E., Wells, P. S., Johnson, R. E., Hoffman, H. J. and Zuelzer, W. A. (2004) 'Diagnosis of Lower- Extremity Deep Vein Thrombosis in Outpatients with Musculoskeletal Disorders: A National Survey Study of Physical Therapists.' *Physical Therapy*, 84(8) pp.717-728.
- Roman, W., Brown, C., Richardson, W., Isaacs, R., Howes, C. and Cook C. (2010) 'The development of a clinical decision making algorithm for detection of osteoporotic vertebral compression fracture or wedge deformity.' *Journal of Manual and Manipulative Therapy*, 18(1) pp. 44-49.
- Ross, M. D. and Boissonault, W. G. (2010) 'Red Flags: To Screen or Not to Screen?' *Journal of Orthopaedic and Sports Physical Therapy*, 40(11) pp. 682-684.
- Rousseau, A., Rozenberg, P. and Ravaud, P. (2015) 'Assessing Complex Emergency Management with Clinical Case-Vignettes: A Validation Study.' *PLoS ONE*, 10(9) pp. 1-12. [Online] [Accessed on 19th January 2017] DOI:10.1371/journal.pone.0138663.
- Rowe, M. and Oltmann, C. (2016) 'Randomised controlled trials in educational research: Ontological and epistemological limitations.' *African Journal of Health Professions Education*, 8(1) pp. 6-8.
- Rushton, A., Rivett, D., Flynn, T., Hing, W. and Kerry, R. (2014) 'International Framework for examination of the cervical region for potential of Cervical Arterial Dysfunction prior to Orthopaedic Manual Therapy intervention.' *Manual Therapy*, 19(3) pp. 222-228.
- Scharff, J. R. and Naunheim, K. S. (2007) 'Traumatic Diaphragmatic Injuries. 'Thoracic Surgery Clinics, 17(1), pp. 81-85.

- Schämann, A., Scheermesser, M., Stegen, C., Nast, I., Allet, L. and Bürge, E. (2011) 'Direktzugang zur Physiotherapie in der Schweiz.' Paper presented at: *Bildungs- und Unternehmerforum*. Kursaal, Bern, 30th September.
- Scheele, J., Vifvinkel, F., Rigter, M., Swinkels, I. C. C., Bierman-Zeinsträ, S. M. A., Koes, B. W. and Luijsterburg, P. A. J. (2014) 'Direct Access to Physical Therapy for Patients with Low Back Pain in the Netherlands: Prevalence and Predictors.' *Physical Therapy*, 94(3) pp. 363-370.
- Scheermesser, M., Allet, L., Bürge, E., Stegen, C., Nast, I. and Schämann, A. (2011) 'Direct Access to Physiotherapy in Switzerland: Cross-Cultural Adaption of a Questionnaire and Investigation of Physiotherapists' Attitude.' *Physioscience*, 7 pp. 143-149.
- Schmidt, H. G., Machiels-Bongaerts, M., Hermans, H., ten Cate, T. J., Venekamp, R. and BoshuizenH, P. A. (1996) 'The Development of Diagnostic Competence: Comparison of a Problem-based, an Integrated, and a Conventional Curriculum.' *Academic Medicine*, 71(6) pp: 658-664.
- Schmidt, H. G., Wagener, S. L., Smeets, G, ACM., Keemink, L. M. and van der Molen, H. T. (2015) 'On the Use and Misuse of Lectures in Higher Education.' *Health Professions Educations*, 1(1) pp. 12-18.
- Schwartzstein, R. M. and Roberts, D. H. (2017) 'Saying Goodbye to Lectures in Medical School – Paradigm Shift or Passing Fad?' *The New England Journal of Medicine*, 377(7) pp. 605-607.
- Segal, J. B., Eng, J., Tamariz, J. L. and Bass, E. B. (2007) 'Review of the Evidence on Diagnosis of Deep Venous Thrombosis and Pulmonary Embolism.' *Annals of Family Medicine*, 5(1) pp. 63-73.
- Sekhon, M., Cartwright, M. and Francis, J. J. (2017) 'Acceptability of health care interventions: an overview of reviews and development of a theoretical framework.' *BMC Health Services Research*, 17(1):88 [Online] [Accessed on 1st January 2018] Doi: 10.1186/s12913-017-2031-8.

- Shanyinde, M., Pickering, R. M. and Weatherall, M. (2011) 'Questions asked and answered in pilot and feasibility randomised controlled trials.' *BMC Medical Research Methodology*, 11:117 pp. 1-11 [Online] [Accessed on 1st August 2018] DOI: 10.1186/1471-2288-11-117
- Shirliff, M. E. and Mader, J. T. (2002) 'Acute Septic Arthritis.' *CLINICAL MICROBIOLOGY REVIEWS*, 15(4) pp. 527-544.
- Shoemaker, M. J. (2012) 'Direct Consumer Access to Physical Therapy in Michigan: Challenges to Policy Adoptions.' *Physical Therapy*, 92(2) pp. 236-250.
- Shroyer, S. R. and Mehta, S. (2013) 'A More Sensitive Risk Stratification Tool for Identifying Spine Infection Than "Red Flags" or Fever.' *Annals of Emergency Medicine*, 62(48), pp. S7-S8 [Online] [Accessed on 28th August 2016] DOI: <http://doi.org/10.1016/j.annemergmed.2013.07.303>.
- Silveira, P. C., Ip, I. K., Goldhaber, S. Z., Piazza, G., Benson, C. B. and Khorasani R. (2015) 'Performance of Wells Score for Deep Venous Thrombosis in the Inpatient Setting.' *JAMA Internal Medicine*, 175(7) pp. 1112-1117. [Online] [Accessed on 20th November 2017] DOI: 10.1001/jamainternmed.2015.1687.
- Singleton, J. and Edlow, J. A. (2016) 'Acute Non Traumatic Back Pain: Risk Stratification, Emergency Department Management, and Review of Serious Pathologies.' *Emergency Medicine Clinics of North America*, 34(4) pp. 743-757.
- Smith, B. E., Diver, C. J. and Taylor, A. J. (2014) 'Cervical Spondylotic Myelopathy presenting as mechanical neck pain: a case report.' *Manual Therapy*, 19(4) pp. 360-364.
- Smith, J. W., Chalupa, P. and Shabaz Hasan, M. (2006) 'Infectious arthritis: clinical features, laboratory findings and treatment.' *Clinical Microbiology and Infection*, 12(4) pp. 309-314.
- Smyth, M. P. and Koh, J. L. (2015) 'A review of surgical and nonsurgical outcomes of medial knee injuries.' *Sports medicine and arthroscopy review*, 23(2) pp. e15-22. [Online] [Accessed on 20th of January 2017] DOI: 10.1097/JSA.0000000000000063.

Sorge, M. (2017) 'Ihre Meinung und weitere Schritte zum Direktzugang.' (Your opinion and further steps to direct access). *Physioinform*, 5: e8-e9.

Srinivasan, M., Wilkes, M., Stevenson, F., Nguyen, T. and Slavin, S. (2007) 'Comparing Problem-Based Learning with Case-Based Learning: Effects of a Major Curricular Shift at Two Institutions.' *Academic Medicine*, 82(1) pp. 74-82.

Stiel, I. G., Wells, G. A., Hoag, R. H., Sivilotti, M. L., Cacciotti, T. F., Verbeek, P. R., Greenway, K. T., McDowell, I., Cwinn, A. A., Greenberg, G. H., Nichol, G. and Michael, J. A. (1997) 'Implementation of the Ottawa Knee Rule for the use of radiography in acute knee injuries.' *JAMA*, 278(23) pp. 2075-2079.

Stiel, I. G., Clement, C. M., Grimshaw, J., Brison, R. J., Rowe, B. H., Schull, M. J., Lee, J. S., Brehaut, J., McKnight, R. D., Eisenhauer, M. A., Dreyer, J., Letovsky, E., Rutledge, T., MacPhail, I., Ross, S., Shah, A., Perry, J. J., Holroyd, B. R., Ip, U., Lesiuk, H. and Wells, G. A. (2009) 'Implementation of the Canadian C-Spine Rule: prospective 12 centre cluster randomised trial.' *BMJ*, 339:b4146, pp. 1-7 [Online] [Accessed on 4th April 2016] DOI: 10.1136/bmj.b4146.

Subramaniam, R. M., Snyder, B., Heath, R., Tawse, F. and Sleight, J. (2006) 'Diagnosis of Lower Limb Venous Thrombosis in Emergency Department Patients: Performance of Hamilton and Modified Wells Scores.' *Annals of Emergency Medicine*, 48(6) pp. 678-685.

Suckley, J. (2012) '*CORE CLINICAL COMPETENCIES FOR EXTENDED-SCOPE PHYSIOTHERAPISTS WORKING IN MUSCULOSKELETAL (MSK) INTERFACE CLINICSBASED IN PRIMARY CARE: A DELPHI CONSENSUS STUDY.*' PH.D. University of Salford.

Sullivan, G. M. (2011) 'Getting Off the "Gold Standard": Randomized Controlled Trials and Education Research.' *Journal of Graduate Medical Education*, 3(3) pp. 285-289.

Summers, A., (2005) 'Recognising and treating Colle's type fractures in emergency care settings.' *Emergency Nurse*, 13(6) pp. 26-33.

Tärnvik, A. (2007) 'Revival of the case method: a way to retain student-centred learning in a post-PBL era.' *Medical Teacher*, 29:1, pp. e32-e36. [Online] [Accessed on 2nd February 2018] DOI: 10.1080/01421590601039968.

Terry, W. and Higgs, J. (1993) 'Educational programmes to develop clinical reasoning skills.' *Australian Journal of Physiotherapy*, 39(1) pp. 47-51.

Thistlethwaite, J. E., Davies, D., Ekeocha, S., Kidd, J. M., MacDougall, C., Matthews, P., Purkis, J. and Clay, D. (2012) 'The effectiveness of case-based learning in health professional education. A BEME systematic review: BEME Guide No. 23.' *Medical Teacher*, 34(6) pp. e421-444. [Online] [Accessed on 2nd February 2018] DOI: 10.3109/0142159X.2012.680939.

Todd, N. V. (2017) 'Guidelines for cauda equine syndrome. Red flags and white flags. Systematic review and implications for triage.' *British Journal of Neurosurgery*, 31(3) pp. 336-339.

Torgerson, C. J. (2002) 'Educational research and randomised trials.' *Medical education*, 36(11) pp. 1002-1003.

Torjesen, I. (2019) 'Self referral to physiotherapy for back pain reduces pressure in GP appointments.' *BMJ*, 364:1870 [Online] [Accessed on 8th July 2019] doi: 10.1136/bmj.l870.

Trecharichi, E. M., Di Meco, E., Mazzotta, V. and Fantoni, M. (2012) 'Tuberculous spondylodiscitis: epidemiology, clinical features, treatment, and outcome.' *European Review for Medical and Pharmacological Sciences*, 16(Supplement 2) pp. 58-72.

Troestrup, J., Juhl, C. B. and Mikkelsen, L. R. (2017) 'Effect of extended scope physiotherapists assessments in orthopaedic diagnostic setting: a systematic review.' *Physiotherapy*. [Online] 'First online' published 30th August 2017. [Accessed on 22 July 2018] DOI: <http://dx.doi.org/10.1016/j.physio.2017.08.004>

Underwood, M. (2009) 'Diagnosing Acute Nonspecific Low Back Pain: Time to Lower the Red Flags?' *Arthritis & Rheumatism*, 60(10) pp. 2855-2857.

Underwood, M. and Buchbinder, R. (2013) 'Red Flags for back pain – A popular idea that didn't work and should be removed from guidelines.' *BMJ*, 347:f7432, pp. 1-2. [Online] [Accessed on 31th of May 2016] DOI: 10.1136/bmj.f7432.

Vaismoradi, M., Turunen, H. and Bondas, T. (2013) 'Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study.' *Nursing and Health Sciences*, 15(3) pp. 398-405.

Vandenbroucke, J. P., von Elm, E., Altmen, D. G., Gotzsche, P. C., Mulrow, C. D., Pocock S. J., Poole, C., Schlesselman, J. J. and Egger, M. (2007) 'Strengthening the Reporting of Observational Studies in Epidemiology (STROBE): Explanation and Elaboration.' *Annals of Internal Medicine*, 147(8), pp. 163-194 [Online] [Accessed on 14th February 2017] DOI: 10.7326/0003-4819-147-8-200710160-00010-w1.

VanGeest, J. G., Johnson, T. P. and Welch, V. L. (2007) 'Methodologies for Improving Response Rates in Survey of Physicians: A Systematic Review.' *Evaluations & the Health Professions*, 30(4) pp. 303-321.

Van Tulder, M., Becker, A., Bekkering, T., Breen, A., Gil del Real, M. T., Hutchinson, A., Koes, B., Laerum, E. and Malmivaara, A. (2006) 'European guidelines for the management of acute non specific low back pain in primary care.' *European Spine Journal*, 15 (Supplement 2) pp.169-191 [Online] [Accessed on 15th August 2017] doi:10.1007/s00586-006-1071-2.

Vaughn, D. W., Shoemaker, M. J., DaPrato, D., Murray, K. S. and Huisen, J. V. (2011) 'The Ability of Final-Year Doctor of Physical Therapy Students to Make Keep/Refer Decisions.' *Journal of Physical Therapy Education*, 25(3) pp. 60-67.

- Veloski, J., Tai, S., Evans, A. and Nash, D. B. (2005) 'Clinical Vignette-Based Surveys: A Tool for Assessing Physician Practice Variations.' *American Journal of Medical Quality*, 20(3) pp. 151-157.
- Verhagen, A. P., Downie, A., Popal, N., Maher, C. and Koes, B. W. (2016) 'Red flags presented in current low back pain guidelines: a review.' *European Spine Journal*. [Online] 'First online' published 4th July 2016. [Accessed on 27th July 2016] DOI: 10.1007/s00586-016-4684-0.
- Verhagen, A. P., Downie, A., Maher, C. and Koes, B. W. (2017) 'Most red flags for malignancy in low back pain guidelines lack empirical support: a systematic review.' *Pain*, 158(10) pp. 1860-1868.
- Wahl, C. E., Smith, D., Sesto, M. and Boissonnault, W. G. (2013) 'Differential Diagnosis of a patient with low back and toe pain.' *Journal of Manual and Manipulative Therapy*, 21(2) pp. 81-89.
- Wallace, E., Uijen, M. J. M., Clyne, B., Zarabzadeh, A., Keogh, C., Galvin, R., Smith, S. M. and Fahey T. (2016) 'Impact Analysis studies of clinical prediction rules relevant to primary care: a systematic review.' *BMJ open*, 6(3) pp. 1-14. [Online] [Accessed on 24th October 2016] DOI:10.1136/bmjopen-2015-009957.
- Wells, P. S., Hirsh, J., Anderson, D. R., Lensing, A. W., Foster, G., Kearon, C., Weitz, J., D'Ovidio, R., Cogo, A. and Prandoni, P. (1995) 'Accuracy of clinical assessment of deep-venous thrombosis.' *The Lancet*, 345(8961) pp. 1326-1330.
- Wells, P. S., Anderson, D. R., Bormanis, J., Guy, F., Mitchell, M., Gray, L., Clement, C., Robinson, K. S. and Lewandowski B. (1997) 'Value of assessment of pretest probability of deep-vein thrombosis in clinical management.' *Lancet*, 350(9094) pp. 1795-1798.

Wells, P. S., Anderson, D. S., Bormanis, J., Guy, F., Mitchell, M., Gray, L., Clement, C., Robinson, K. S. and Lewandowski, B. (1999) 'Application of a diagnostic clinical model for the management of hospitalized patients with suspected deep-vein thrombosis.' *Thrombosis and Haemostasis*, 81(4) pp. 493-497.

Whitley, E. and Ball, J. (2002) 'Statistics review 1: Presenting and summarising data.' *Critical Care*, 6(1) pp. 66-71.

Williams, C.M., Henschke, N., Maher, C.G., van Tulder, M.W., Koes, B.W., Macaskill, P. and Irwig, L. (2013) 'Red Flags to screen for vertebral fracture in patients with low-back pain (Review).' *Cochrane Database of Systematic Reviews*, 1: CD008643, pp. 1-38. [Online] [Accessed on 3rd October 2016] DOI: 10.1002/14651858.CD008643.pub2.

World Confederation for Physical Therapy (WCPT) (2007) '*Declaration of Principle: Ethical Principles*.' WCPT: London. [Online] [Accessed on 3rd October 2015] [https://www.wcpt.org/sites/wcpt.org/files/files/WCPT-DoP-Ethical Principles-Aug07.pdf](https://www.wcpt.org/sites/wcpt.org/files/files/WCPT-DoP-Ethical_Principles-Aug07.pdf)

World Confederation for Physical Therapy (WCPT). (2011) '*WCPT guideline for physical therapist professional entry level education*.' WCPT: London. [Online] [Accessed on 3rd October 2015] https://www.wcpt.org/sites/wcpt.org/files/files/Guideline_PTEducation_complete.pdf

World Confederation for Physical Therapy (WCPT). (2011) '*WCPT policy Statement: Education*.' WCPT: London. [Online] [Accessed on 3rd October 2015] https://www.wcpt.org/sites/wcpt.org/files/files/resources/policies/2017/PS_Education_FINAL.pdf

World Confederation for Physical Therapy (WCPT). (2011) '*Policy statement: Description of physical therapy*'. WCPT: London. [Online] [Accessed on 3rd October 2015] https://www.wcpt.org/sites/wcpt.org/files/files/PS_Description_PT_Sept2011_FORMATTED_edit2013.pdf

World Confederation for Physical Therapy, WCPT. (2011) '*WCPT standards of physical therapy practice*'. WCPT: London. [Online] [Accessed on 3rd October 2015]
https://www.wcpt.org/sites/wcpt.org/files/files/Guideline_standards_practice_complete.pdf

World Confederation for Physical Therapy (WCPT). (2017) *Policy Statement: Description of Physical Therapy*. 18th April. [Online] [Accessed 4th June 2019]
<https://www.wcpt.org/policy/ps-descriptionPT>

Young, B. A. and Flynn, T. W. (2005) 'Pulmonary Emboli: The Differential Diagnostic Dilemma.' *Journal of Orthopaedic and Sports Physical Therapy*, 35(10) pp. 637-644.

Yusuf, M., Finucane, L. and Selfe, J. (2018) *Red flags for the early detection of Spinal Infection in back pain patients? A Scoping Review*. [Poster] Birmingham: Date viewed August 28th 2018.

Yusuf, T. E. and Baron, T. H. (2006) 'Endoscopic transmural drainage of pancreatic pseudocysts: results of a national and an international survey of ASGE members.' *Gastrointestinal Endoscopy*, 63(2) pp. 223-227.

Appendices

Appendix 1: Clinical prediction rules to rule out fractures of the foot/ankle, knee joint, cervical spine and proximal deep venous thrombosis.

The Ottawa ankle rules

The Ottawa ankle rules are thought to rule out bony injuries of the ankle and midfoot after a traumatic event. If negative, the Ottawa ankle rules should decrease unnecessary imaging of the ankle and midfoot region and, as a consequence, reduce costs for the health care system.

The Ottawa ankle rules (as seen in Figure Appendix 1.1.1) have a reported sensitivity of 100% and reduce the amount of inappropriate imaging (x-ray) by 30-40% (Bachmann et al., 2003).

Permission obtained.

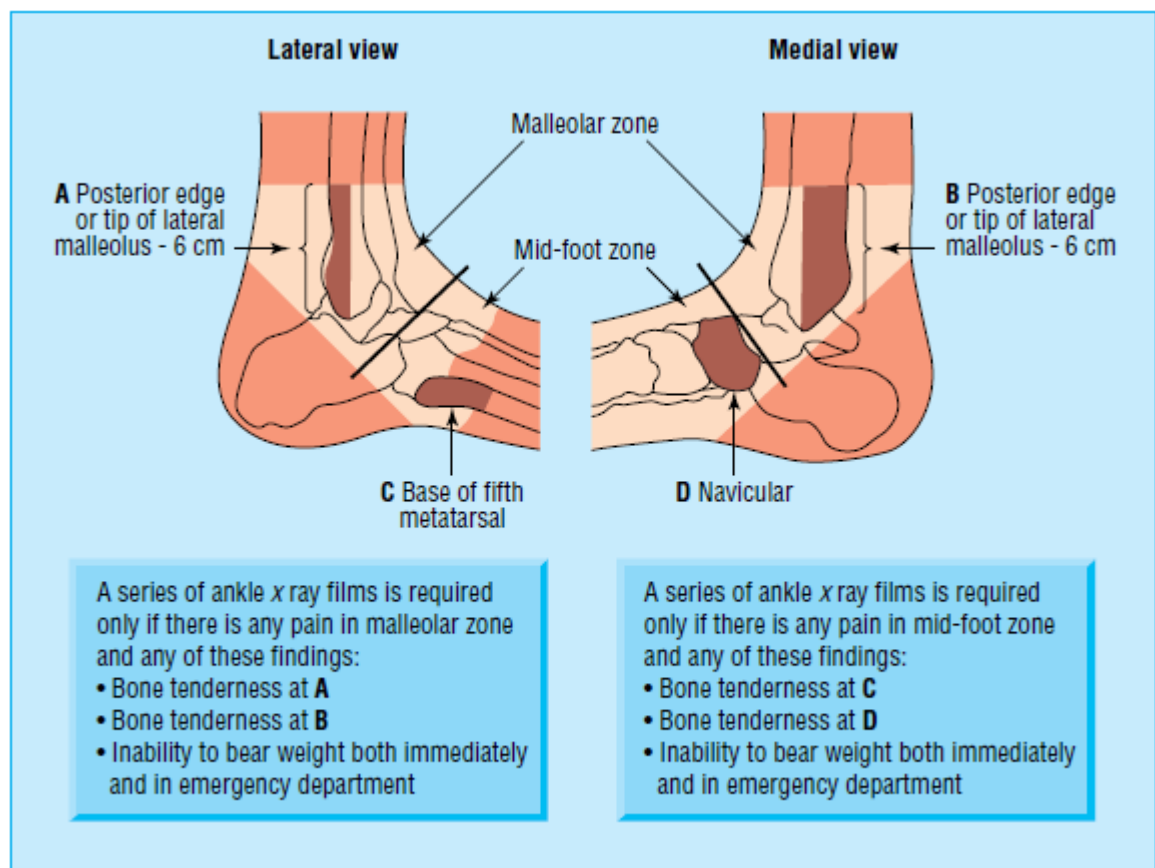


Figure Appendix 1.1.1: Ottawa ankle rule.

Ottawa knee rule

Similar to the Ottawa ankle rules, the Ottawa knee rule (as seen in figure Appendix 1.1.2) has almost 100% sensitivity and seems highly useful to rule out fractures of the knee after a traumatic injury to the knee joint (Emparanza and Aginaga, 2001).

Moreover, the Ottawa ankle rule has been reported to decrease the use of (inappropriately ordered) radiographs by 26.4% (Stiel et al., 1997). Permission obtained.

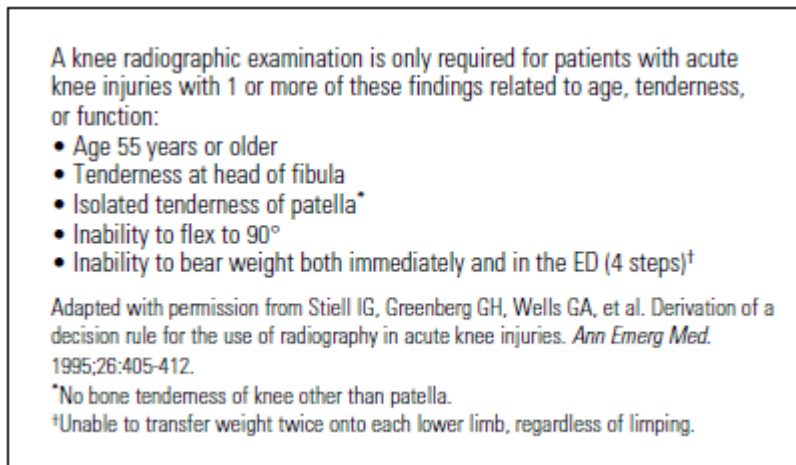


Figure Appendix 1.1.2: Ottawa knee rule.

The Canadian c-spine rule

The Canadian c-spine rule (figure Appendix 1.1.3) has been extensively tested in a large trial involving 12 emergency hospitals in Canada and has been shown to accurately rule out (100% sensitivity) fractures of neck pain after a traumatic event (Stiel et al., 2009). During the study period, 23 patients with spinal fracture in the neck were identified and no single case was overlooked (Stiel et al., 2009). Apart from its excellent diagnostic capabilities, the Canadian c-spine rule reduced imaging of the neck by 12.8% (Stiel et al., 2009).

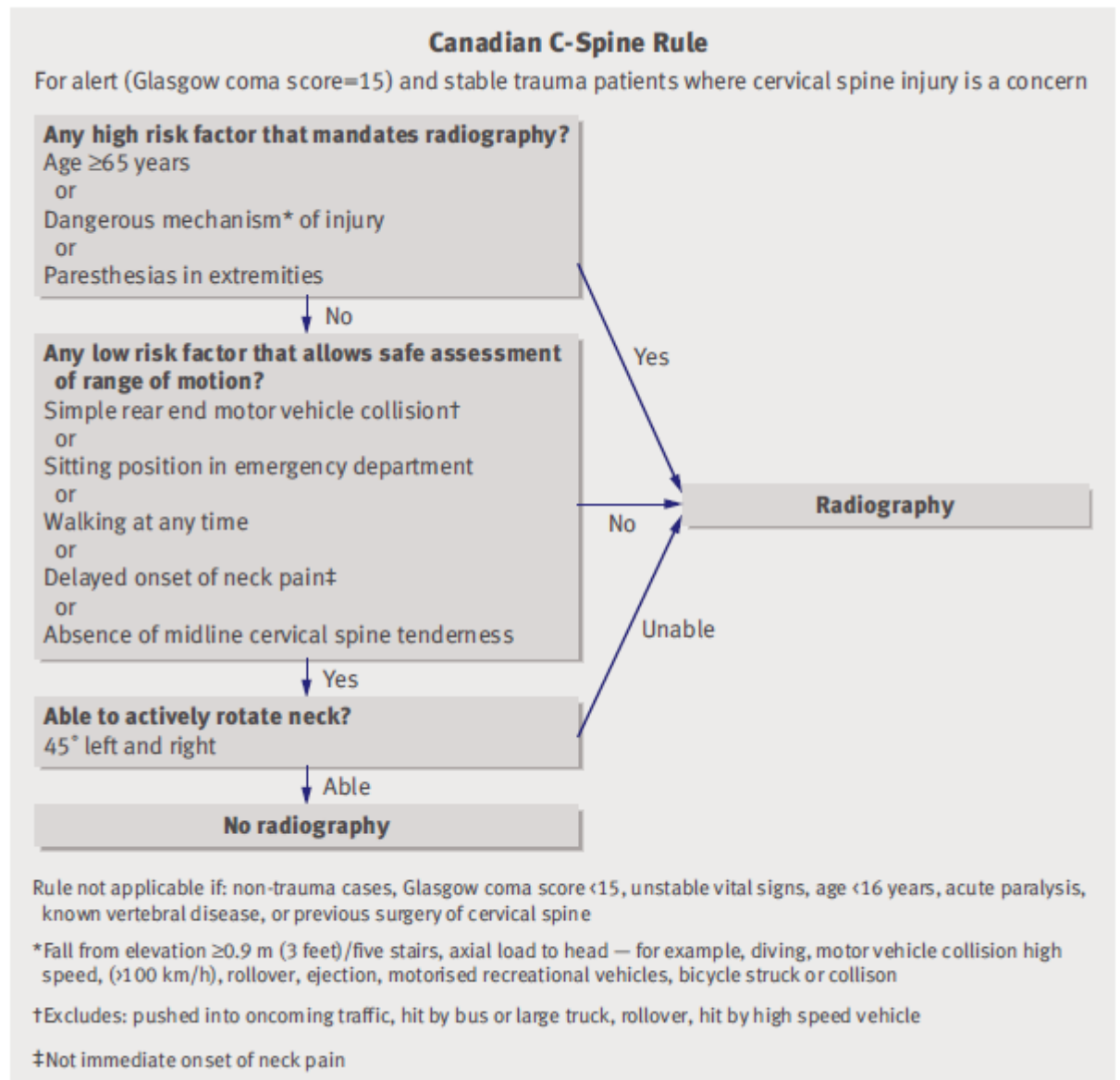


Figure Appendix 1.1.3: Canadian C-Spine rule.

Wells Score

Another commonly described and also among physiotherapists rather popular diagnostic CPR is the one to determine the pre-test probability of suffering from a deep venous thrombosis (DVT) of the lower limbs. 249000 new cases of deep venous thromboembolism occur in the United States each year (Heit, 2006). Since advanced age, being hospitalized, paralysis of the extremities (possibly due to neurological conditions) and immobilization after (major) surgery (e.g. total hip/knee replacement) are common risk factors for developing DVT (Heit, 2006), physiotherapists will most certainly see patients with a DVT during their career (Young and Flynn, 2005). The major concern with especially proximal deep venous thrombosis of the lower limbs is that it

can further develop to pulmonary embolism (Engelberger et al., 2011) which is a possibly life threatening condition with a high mortality rate that requires immediate medical attention (Heit, 2006). The CPR to identify patients who are likely to have a DVT of the leg was initially developed by Wells et al. (1995) and then validated in an outpatient (e.g. ambulatory care, community health centre, private practice) (Wells et al., 1997) and an emergency setting (Subramaniam et al., 2006). Figure Appendix 1.1.4 shows the adapted version by Wells et al. (1997) which was established to enhance overall clinical applicability.

Clinical Finding	Score ^a
Active cancer (within 6 months of diagnosis or palliative care)	1
Paralysis, paresis, or recent plaster immobilization of lower extremity	1
Recently bedridden >3 days or major surgery within 4 weeks of application of clinical decision rule	1
Localized tenderness along distribution of the deep venous system ^b	1
Entire lower-extremity swelling	1
Calf swelling by >3 cm compared with asymptomatic lower extremity ^c	1
Pitting edema (greater in the symptomatic lower extremity)	1
Collateral superficial veins (nonvaricose)	1
Alternative diagnosis as likely or greater than that of deep vein thrombosis ^d	-2

^a Score interpretation: ≤ 0 =probability of proximal lower-extremity deep vein thrombosis (PDVT) of 3% (95% confidence interval [CI]=1.7%–5.9%), 1 or 2=probability of PDVT of 17% (95% CI=12%–23%), ≥ 3 =probability of PDVT of 75% (95% CI=63%–84%).

^b Tenderness along the deep venous system is assessed by firm palpation in the center of the posterior calf, the popliteal space, and along the area of the femoral vein in the anterior thigh and groin.

^c Measured 10 cm below tibial tuberosity.

^d Most common alternative diagnoses are cellulitis, calf strain, and postoperative swelling.

Figure Appendix 1.1.4: Wells Score (Permission obtained).

Knox et al. (2016) described the CPR by Wells et al. (1997) to have reached impact analysis. However, the Wells score (Wells et al., 1997) is not included in a recently

published systematic review of CPRs who have reached impact analysis (Wallace et al., 2016).

Moreover, even though it is true that the modified Wells score which helps to establish the pre-test probability of suffering from a DVT of the lower limbs has already been validated on two different occasions (Wells et al., 1997; Subramaniam et al., 2006) and is described in one systematic review (Segal et al., 2007) and one meta-analysis (Geersing et al., 2014) as a particularly accurate screening tool for suspected DVT of the lower extremities, Engelberger et al. (2011) and Silveira et al. (2015) failed to confirm previous results obtained by Wells et al. (1999) and Constans et al. (2001) for hospitalized patients (in-patient setting). In particular, Silveira et al. (2015) (possibly correctly) criticise the statement by Wells et al. (1999) who describe the Wells score as a safe way to rule out deep venous thrombosis, although 10% (and 9% in the Constans et al. (2001) study) of those being classified of having a low risk actually had a deep venous thrombosis. The results obtained by Silveira et al. (2015) indicate that the Wells score does not seem to be accurate enough to either determine the absolute risk (low, middle, high) of having a DVT or plan further management strategies in an in-patient setting (Silveira et al., 2015). In addition, Engelberger et al. (2011) concluded that, although their results show that the Wells score is a solid tool to rule in/out the presence of a proximal DVT in an outpatient setting, it performed rather poorly to identify those at risk of having an isolated distal DVT. The problem is that the Wells score is often used to identify DVT in general and no distinction is made between distal and proximal DVT (Engelberger et al., 2011).

As a consequence, the Wells score, despite being frequently described as an accurate and safe method to classify patients of having either a low, middle or high risk of suffering from a deep venous thrombosis (proximal and distal) of the lower limbs in various clinical settings (Wells et al., 1997; Wells et al., 1999; Segal et al., 2007; Geering et al., 2014), should only be used when keeping in mind its current (differential) diagnostic limitations (Engelberger et al., 2011).

**Appendix 2: Ethical approval from the Manchester Metropolitan University Ethics
Committee 1390 (Faculty of Health, Psychology and Social Care)**

**MANCHESTER METROPOLITAN UNIVERSITY
FACULTY OF HEALTH, PSYCHOLOGY AND SOCIAL CARE**

M E M O R A N D U M

FACULTY ACADEMIC ETHICS COMMITTEE



To: Wolfgang Lackenbauer

From: Prof Carol Haigh

Date: 02/08/2016

Subject: Ethics Application 1390

Title: Keep/refer decision making abilities of European undergraduate physiotherapy students: Is Austria keeping up with international standards and how can we further develop those abilities?

Thank you for your application for ethical approval.

The Faculty Academic Ethics Committee review process has recommended approval of your ethics application. This approval is granted for 42 months for full-time students or staff and 60 months for part-time students. Extensions to the approval period can be requested.

If your research changes you might need to seek ethical approval for the amendments. Please request an amendment form.

We wish you every success with your project.

A handwritten signature in black ink, appearing to read "Carol Haigh".

Prof Carol Haigh and Prof Jois Stansfield
Chair and Deputy Chair
Faculty Academic Ethics Committee

Appendix 3: Ethical approval from the University of central Lancashire Ethics Committee STEMH 435 (School of Health Sciences)



11 March 2016

James Selfe / Wolfgang Lackebauer / Hazel Roddam
School of Health Sciences
University of Central Lancashire

Dear James / Wolfgang / Hazel

Re: STEMH Ethics Committee Application
Unique Reference Number: STEMH 435

The STEMH ethics committee has granted approval of your proposal application '**Keep/refer decision making abilities of European undergraduate physiotherapy students: Is Austria keeping up with international standards and how can we further develop those abilities?**'. Approval is granted up to the end of project date* or for 5 years from the date of this letter, whichever is the longer.

It is your responsibility to ensure that

- the project is carried out in line with the information provided in the forms you have submitted
- you regularly re-consider the ethical issues that may be raised in generating and analysing your data
- any proposed amendments/changes to the project are raised with, and approved, by Committee
- you notify roffice@uclan.ac.uk if the end date changes or the project does not start
- serious adverse events that occur from the project are reported to Committee
- a closure report is submitted to complete the ethics governance procedures (Existing paperwork can be used for this purposes e.g. funder's end of grant report; abstract for student award or NRES final report. If none of these are available use [e-Ethics Closure Report Proforma](#)).

Yours sincerely

Vice Chair
STEMH Ethics Committee

* for research degree students this will be the final lapse date

NB - Ethical approval is contingent on any health and safety checklists having been completed, and necessary approvals as a result of gained.

Appendix 4: Permission to conduct research from Lahti University of Applied Sciences.

LAMK

RESEARCH PERMIT

23.5.2016

Name of applicant:

Wolfgang Lackenbauer
University of Central Lancashire
Preston, Lancashire/UK, PR1 2 HE
wlackebauer@uclan.ac.uk

Date of receipt: May 20th, 2016

The research permit shall be issued to the PhD research, which aims at analysing how final year undergraduate physiotherapy students complete clinical vignettes, under the condition that the applicant will comply with the guidelines for good scientific practice as published by the National Advisory Board on Research Ethics in Finland. (http://www.tenk.fi/en/good_scientific_practice/Hyva_Tieteellinen_ENG.pdf)

Lahti University of Applied Sciences does not provide information about its staff or students for research purposes, but it can circulate research requests to the groups in question. Take contact to the contact person or to the Student office of the relevant faculty.

☒ **Yes**

When the research has been published, please send a copy to the Lahti University of Applied Sciences.

Contact person at Lahti University of Applied Sciences is Senior Lecturer Eija Viitala;
Email: eija.viitala@lamk.fi, Phone: +358 44 7081709

☐ **No**

Lahti

23.5.2016

Place

Date


Ilkka Väänänen, Research Director



Appendix 5: Permission to conduct research from Satakunta University of Applied Sciences.



SATAKUNNAN AMMATTIKORKEAKOULU
SATAKUNTA UNIVERSITY OF APPLIED SCIENCES

OP21B

SAMK / Application for a research permission	
<p>For theses and other studies which concern Satakunta University of Applied Sciences.</p> <p>Please enclose the research plan approved by your thesis supervisor. Send the application to SAMK's Quality Manager well before the planned period of implementation (procedural instructions ME71110). Do not start the empirical part of the research before you have obtained the permission.</p>	
Researcher(s)/Student(s):	Wolfgang Lackenbauer
Address:	
E-mail:	wlackebauer@uclan.ac.uk
The working title of the thesis/study:	Keep/refer decision making abilities of European undergraduate physiotherapy students
Planned timetable of implementation:	August/September 2016
Degree programme in which the applicant is studying:	PhD via MPhil
Educational institution if other than SAMK:	University of central Lancashire
<p>Shall personal data** be collected and registered during research? <input type="checkbox"/> yes <input checked="" type="checkbox"/> no</p> <p>** Collecting and registering personal data refers to the collecting of individualised data (such as name, personal identity code, date of birth) and research data into a register. (Further information www.tietosuoja.fi). Upon completion of the research work, the register shall be either deleted or filed without identification data.</p>	
Supervisor(s):	Prof James Selfe, Dr Jessie Janssen, Dr Hazel Roddam
Supervisor's approval:	I APPROVE WOLFGANGS APPROACH
Supervisor's opinion:	TO REQUEST HELP FROM SAMK.
Supervisor's signature	WOLFGANG IS AN EXCELLENT STUDENT AND ADHERES TO ALL THE APPROPRIATE INTERNATIONAL STANDARDS FOR RESEARCH ETHICS & RESEARCH GOVERNANCE
Date and place	10/6/16 MANCHESTER U.K.
Applicant's signature	

Quality Manager's decision

- ☒ permission is granted
☐ permission is granted conditionally
☐ permission is not granted

Grounds; if permission is not granted or is granted conditionally:

21.6.2016 Pori


Date and place

Erja Kuusela

Quality Manager

Note: The decision shall be notified to the student(s), the supervisor(s) and the contact person at SAMK.

Appendix 6: Permission to conduct research from Tampere University of Applied Sciences.

Applicant data	Name Wolfgang Lackenbauer	Identity number			
	Address	Postal code 5020	Town Salzburg		
	Telephone	Email address wlackebauer@uclan.ac.uk			
	Research institute, educational institution or other community University of Central Lancashire	Applicant's job or position PhD student			
Orderer	Orderer				
	Contact information				
Date and signature	Place and date 8/6/16		Signature 		
Research permit granter fills in	Granting of research permit <input checked="" type="checkbox"/> Research permit granted <input type="checkbox"/> Research permit not granted				
	Conditions for granting: <input checked="" type="checkbox"/> The research permit is granted and data submitted on the condition that the author of the research commits him/herself to complete data processing in accordance with the personal data legislation. The author has the obligation to use data in confidence and only for this particular research. After the research has been completed, the data have to be deleted appropriately. <input type="checkbox"/> The applicant has to deliver the final report after the research has been completed and present the results orally <input checked="" type="checkbox"/> Other conditions: <i>The applicant will deliver the final report after the research has been completed.</i>				
	Grounds for refusing research permit				
	Decision-maker's name <i>Riitta Hanhijärvi, Director of Education</i>				
Date and granter's signature	Place and date <i>Tampere 16/6/2016</i>		Signature <i>Riitta Hanhijärvi</i>		
Information on decision	<input checked="" type="checkbox"/> research permit applicant <input type="checkbox"/> director of school or unit				
	<input checked="" type="checkbox"/> other, name: <i>Marja-Leena Lähdenmäki</i> <i>Head of Degree Programme in Physiotherapy</i>				

Appendix 7: Initial e-mail which was sent to ENPHE member institutions.

I am a physiotherapist from Austria, currently undertaking my PhD research at the University of Central Lancashire in Preston/UK. This is an exciting new project that will generate valuable insights into how new graduate physios across the EU countries make clinical decisions about case management. The findings will be highly relevant to all of us involved in professional clinical education.

As part of my research project, I would like to send a survey to a number of final year undergraduate physiotherapy students_ within 3 months of their graduation._

So I would be very grateful if you could give me details when the graduation/final exams take place at your University?

If you have any questions please do not hesitate to contact me.

Kind regards

Wolfgang Lackenbauer

Appendix 8: 12 vignettes from chapter 5.

- #1 A 65-year-old man with a history of COPD and significant cigarette smoking complains of bilateral buttocks cramping associated with stair climbing beginning about 6 months ago. Over the past 2 months, the cramping has become associated with walking as well. When he stops walking and stands still, the cramping decreases and then disappears. No reflex or sensory changes are detected, and the pain is not affected by trunk flexion or extension. **(Keep and Refer, Refer; vascular disease, claudication)**
- #2 A 35-year-old woman who is healthy and an occasional jogger complains of pain in the anterolateral aspect of the forefoot starting about 3 days ago. The pain started when she was running and is exacerbated by any weight bearing. There is moderate tenderness to palpation; no swelling or redness is noted. Foot and ankle ROM are grossly WNL. **(Keep and Refer, Refer; fifth metatarsal fracture)**
- #3 A 40-year-old woman who is healthy, but inactive, complains of sudden onset of low back pain after slipping off a curb and nearly falling. The pain increases with movement and is relieved with lying down. There is no motor or sensory loss. The patient reports some moderate muscular tenderness to palpation in the thoracic area in the right side. **(Keep, Keep and Refer; non-specific low back pain)**
- #4 A 39-year-old woman complains of 6–9 months of intermittent dull aching in the posterior cervical, occipital, and interscapular areas. There is local muscular tenderness and pain with movement. ROM of the neck is slightly decreased. There is no dizziness, radiation of pain to the upper limbs, or motor or sensory loss. **(Keep, Keep and Refer; non-specific neck pain)**
- #5 A 60-year-old man who apparently is healthy, but inactive, complains of sudden onset of pain in the right knee with no known precipitating incident. The joint is very tender, warm, and red. ROM is painful and decreased. No other previous or current joint complaints are reported. **(Refer; septic joint)**
- #6 A 65-year-old man, former football player and current tennis player, complains of bilateral knee pain, worsening over the last 6 months. The pain is affecting his leisure activities as it increases with activity and movement. He reports a feeling of grinding in his knee. No swelling is noted, and the ROM is WNL. **(Keep, Keep and Refer; osteoarthritis)**
- #7 An 80-year-old active but frail woman fell on a rug in her apartment and landed on her outstretched hands. She complains of tenderness over the lateral aspect of the right wrist and distal forearm, and a bony deformity is palpable. Her wrist is swollen and painful, with decreased ROM. **(Keep and Refer, Refer; wrist fracture)**
- #8 A 17-year-old girl complains of knee pain following an injury that occurred when she was running in from the outfield during a softball game and stepped in a hole. She was unable to compete in the remainder of the game. The medial aspect of the knee is generally tender to palpation and slightly swollen. Pain is increased at the ends of ROM and with valgus stress. No complaints of knee locking. **(Keep, Keep and Refer; collateral ligament sprain)**
- #9 A 70-year-old man complains of a dull, aching, constant thoracolumbar pain that has been increasing over the past 2 days. The pain is aggravated by general activity, but no particular posture or movement of the trunk increases or decreases the pain more than another. Pain is not radiating, and no sensory or motor changes are noted. **(Refer; aneurysm)**
- #10 A 53-year-old woman with a fairly sedentary lifestyle complains of a sudden onset of deep, dull, aching pain in the center of the chest, aggravated by movement of the left arm. She cannot identify a precipitating incident or injury. The pain is not radiating, and there is extreme tenderness to palpation lateral to the sternum. Coughing and sneezing increase the pain. **(Keep, Keep and Refer; costochondritis)**

#11 A 55-year-old woman complains of constant, intense aching back pain subcostally on the right side over the past 2–3 days. The pain radiates along the iliac crest on the right side. She cannot identify a precipitating incident or injury. The pain is not affected by positional changes or the use of a heating pad.

(Keep and Refer, Refer; visceral referred pain, GI or GU)

#12 A 45-year-old man complains of mild–moderate, deep, thoracic back pain that is preventing his sleeping at night. The pain is intermittent but has increased over the past 2 weeks and is not relieved by positional changes. It seems to be worse at night than during the day. The patient complains of fatigue that he attributes to not sleeping well.

(Refer; neoplasm)

Appendix 9: Additional questionnaire for Austrian students from chapter 5.

1. Questions about the survey

1.1 How difficult was it for you (in general) to complete the survey?

difficult average easy unsure
☐ ☐ ☐ ☐

1.2 How difficult was it for you to distinguish between the medical critical and musculoskeletal (noncritical medical) cases?

very average easy unsure
☐ ☐ ☐ ☐

2. Questions about your undergraduate education and clinical placement(s)

2.1 Do you feel sufficiently trained to detect the presence/absence of serious medical pathologies?

Yes ☐

No ☐
Unsure ☐

2.2 Have you been obliged to read any specific literature about keep/refer decision making abilities (as part of a lecture)?

Yes ☐
No ☐

If YES: books ☐ journal articles ☐ other scientific papers ☐

2.3 Were keep/refer decision making abilities (screening for serious medical pathologies) an important part of your physical examination process during your clinical internship?

Yes ☐
No ☐

2.4 Did your clinical supervisor(s) specifically ask you to additionally screen patients for the presence/absence of serious medical pathologies?

Yes ☐
No ☐

If YES: Were you obliged to write down your examination findings?

Yes ☐
No ☐

2.5 How confident do you feel when you are asked to report your examination findings (in case you suspect a serious medical pathology) to the referring medical doctor?

Very ☐ average ☐ somewhat ☐ not at all ☐

2.6 Do you believe that keep/refer decision making abilities should be mandatorily taught (as an independent lecture) during the undergraduate physiotherapy?

Yes ☐
No ☐

Unsure

☐

➔ If YES, which year/semester?

3. Questions about the physiotherapeutic profession

3.1 Do you personally believe that screening patients for serious medical pathologies is an integral part of every physical examination?

Yes ☐

No ☐

3.2 Do you believe that every qualified physiotherapist should be capable of screening patients for serious medical pathologies?

Yes ☐

No ☐

3.3 Do you believe that screening for serious medical pathologies (not making a definite diagnosis) is only the task of a medical doctor?

Yes ☐

No ☐

Appendix 10: Study information sheet for Austrian students studying at ENPHE member institutions.



Date 06.06.2106

Name Wolfgang Lackenbauer

Course PhD via MPhil

Department Health, Psychology and Social Care

Building Brooks Building

Manchester Metropolitan University

Tel:

Study Description / Information Sheet for physiotherapy students in Austria (phase one).

Name of the Researchers:

Wolfgang Lackenbauer (wlackebauer@uclan.ac.uk)

Prof James Selfe (J.selfe@mmu.ac.uk)

Dr Jessie Janssen (JJanssen@uclan.ac.uk)

Dr Hazel Roddam (hroddam@uclan.ac.uk)

Background of the study

Recognition of serious pathologies of the neuro-musculoskeletal system, especially in the early stages, is a major challenge for all clinicians. Despite the fact that not all physiotherapists in Europe work in a direct access health care setting (physiotherapy without medical referral), research has shown that physiotherapists (in both direct and non-direct access systems), when using proper screening strategies, can become crucial when it comes to recognizing underlying systemic diseases and various disorders where immediate medical attention is warranted. Therefore, it is crucial that every qualified physiotherapist and physiotherapy student working with patients receives a certain level of education in order to be capable of making an accurate decision if a patient seems suitable for physiotherapeutic management (keep), or not (refer).

Aim of the study

This study aims at gaining proper insight into the current level of the keep/refer decision making abilities of undergraduate physiotherapy students (within 3 months of their graduation) from various European countries (studying and subsequently working in different health care settings).

In addition, this study aims to gather qualitative data of the importance of keep/refer decision making abilities as part of the physiotherapeutic education from the perspective of the participating students in Austria.

Why have you been chosen?

You have been chosen because you are a physiotherapy student (within 3 months of your graduation) currently studying at an Austrian University which is a member institution of the European Network of Physiotherapy in Higher Education (ENPHE).

What will you be asked to do?

In order to assess the keep/refer decision making abilities, you will be asked to fill in this online survey containing 12 concise cases.

You have 3 answer options to choose from (only **one answer per case** possible):

- 1) Providing physiotherapy intervention **without** the need for additional medical evaluation and/or management (**keep**).
- 2) Providing physiotherapy intervention **together with** medical evaluation and/or management (**keep and refer**).
- 3) Referring the patient to a medical professional **without** physiotherapy intervention (**refer**).

You have 15 minutes in order to individually complete the task.

Once you have received the link you will have 2 weeks to participate. After this time it will not be possible to participate anymore.

It is acknowledged that in a real-life clinical setting you would make more tests and have various additional opportunities for making a definite clinical decision. However, in order to make this survey feasible, the descriptions of the cases are intentionally kept short.

In addition, you will be asked to fill in an online questionnaire.

By completing the vignettes and the questionnaire, you are automatically consenting to the study.

What happens when the study stops?

After you have completed this one survey, you will not be contacted or required to participate in an additional survey related to this project.

Confidentiality

The survey and questionnaire will be confidential and anonymous so that you will remain completely unidentifiable.

The survey and questionnaire will be stored on a password-protected device which will be kept securely in a locked cupboard where access is impossible for anybody except the person responsible for the research.

What are the possible disadvantages or risks of taking part?

This is a low risk study where you are solely asked to fill in an online survey.

What will happen to the results of the study?

Results of the study will be used for the main investigator's dissertation and for publication in a peer-reviewed journal.

The results will only be accessible to the main investigator (Wolfgang Lackenbauer) and the supervisor team.

Who has reviewed the study?

The study has been approved by the faculty academic ethics committee at Manchester Metropolitan University/UK.

Who is organizing the study?

This study is part of an on-going dissertation by the main investigator (Wolfgang Lackenbauer) who is studying at Manchester Metropolitan University.

Do you need to take part in the study?

Participation is completely voluntary and you have the right to refuse to participate and withdraw without any consequences (without the need to give any reason). Withdrawal from the study is possible before and after the completion of the survey and questionnaire. However,

once the documents have been sent back, withdrawal is not possible anymore (since the documents are anonymous).

What if there is a problem?

If you have a concern about any aspect of this study, you should ask to speak to Wolfgang Lackenbauer (wolfgang.lackebauer@stu.mmu.ac.uk) who will do his best to answer your questions. If you remain unhappy and wish to complain formally, you can do this by emailing the research supervisor Prof James Selfe (j.selfe@mmu.ac.uk).

Appendix 11: Study information sheet for international students studying at ENPHE member institutions.



**Manchester
Metropolitan
University**

Date 06.06.2016
Wolfgang Lackenbauer
Course PhD via MPhil
Department Health, Psychology and Social Care
Brooks Building
Manchester Metropolitan University
Tel:

Study Description / Information Sheet for physiotherapy students EU (phase one).

Name of the Researchers:

Wolfgang Lackenbauer (wlackebauer@uclan.ac.uk)

Prof James Selfe (j.selfe@mmu.ac.uk)

Dr Jessie Janssen (JJanssen@uclan.ac.uk)

Dr Hazel Roddam (hroddam@uclan.ac.uk)

Background of the study

Recognition of serious pathologies of the neuro-musculoskeletal system, especially in the early stages, is a major challenge for all clinicians. Despite the fact that not all physiotherapists in Europe work in a direct access health care setting (physiotherapy without medical referral), research has shown that physiotherapists (in both direct and non-direct access systems), when using proper screening strategies, can become crucial when it comes to recognizing underlying systemic diseases and various disorders where immediate medical attention is warranted. Therefore, it is crucial that every qualified physiotherapist and physiotherapy student working with patients receives a certain level of education in order to be capable of making an accurate decision if a patient seems suitable for physiotherapeutic management (keep), or not (refer).

Aim of the study

This study aims at gaining proper insight into the current level of the keep/refer decision making abilities of undergraduate physiotherapy students (within 3 months of their graduation) from various European countries (studying and subsequently working in different health care settings).

Why have you been chosen?

You have been chosen because you are a physiotherapy student (within 3 months of your graduation) currently studying at a European Network of Physiotherapy in Higher Education (ENPHE) member institution.

What will you be asked to do?

In order to assess the keep/refer decision making abilities, you will be asked to fill in this online survey containing 12 concise cases.

You have 3 answer options to choose from (only **one answer per case** possible):

- 1) Providing physiotherapy intervention **without** the need for additional medical evaluation and/or management (**keep**).
- 2) Providing physiotherapy intervention **together with** medical evaluation and/or management (**keep and refer**).
- 3) Referring the patient to a medical professional **without** physiotherapy intervention (**refer**).

You have 15 minutes in order to individually complete the task.

Once you have received the link you will have 2 weeks to participate. After this time it will not be possible to participate anymore.

It is acknowledged that in a real-life clinical setting you would make more tests and have various additional opportunities for making a definite clinical decision. However, in order to make this survey feasible, the description of the cases is intentionally kept short.

By completing the vignettes, you are automatically consenting to the study.

What happens when the study stops?

After you have completed this one survey, you will not be contacted or required to participate in an additional survey related to this project.

Confidentiality

The survey will be confidential and anonymous so that you will remain completely unidentifiable.

The survey and questionnaire will be stored on a password-protected device which will be kept securely in a locked cupboard where access is impossible for anybody except the person responsible for the research.

What are the possible disadvantages or risks of taking part?

This is a low risk study where you are solely asked to fill in an online survey.

What will happen to the results of the study?

Results of the study will be used for the main investigator's dissertation and for publication in a peer-reviewed journal.

The results will only be accessible to the main investigator (Wolfgang Lackenbauer) and the supervisor team.

Who has reviewed the study?

The study has been approved by the faculty academic ethics committee at Manchester Metropolitan University/UK.

Who is organizing the study?

This study is part of an on-going dissertation by the main investigator (Wolfgang Lackenbauer) who is studying at Manchester Metropolitan University.

Do you need to take part in the study?

Participation is completely voluntary and you have the right to refuse to participate and withdraw without any consequences (without the need to give any reason). Withdrawal from the study is possible before and after the completion of the online survey. However, once the document has been sent back, withdrawal is not possible anymore (since the document is anonymous).

What if there is a problem?

If you have a concern about any aspect of this study, you should ask to speak to Wolfgang Lackenbauer (wolfgang.lackenbauer@stu.mmu.ac.uk) who will do his best to answer your questions. If you still remain unhappy and wish to complain formally, you can do this by emailing the research supervisor Prof James Selfe (j.selfe@mmu.ac.uk).

Appendix 12: Email correspondence with ENPHE member institutions.

Re: Re: graduation date undergraduate physiotherapy programme

Von:

"physio therapy" <physio.therapy@ucd.ie>

An:

"Wolfgang Lackenbauer" <wolfgang.lackenbauer@gmx.at>

Datum:

13.01.2016 10:44:25

Dear Wolfgang,

We have very strict guidelines regarding emailing students for research purposes. You need to apply to UCD Research Ethics for permission to do so, the school does not email surveys for research purposes.

Kind Regards

Mairead

Appendix 13: E-mail correspondence with ENPHE member institutions.

Re: Aw: Re: graduation date

Von:

"Þjóðbjörg Guðjónsdóttir" <thbjorg@hi.is>

An:

"Wolfgang Lackenbauer" <wolfgang.lackenbauer@gmx.at>

Datum:

29.12.2015 11:47:53

Dear Wolfgang

I will not be able to send the survey to those who graduate from us. Your institution/university must have a partner/co-worker here to perform a research in the country. The research has to be announced to The Data Protection Authority etc. The Directorate of Health in Iceland might be able to give you information.

Sincerely

Bjorg

Appendix 14: E-mail correspondence with ENPHE member institutions.

AW: graduation date physiotherapy students

Von:

"Bauer-Horvath Heike" <heike.bauer-horvath@fh-burgenland.at>

An:

"Wolfgang Lackenbauer" <wolfgang.lackenbauer@gmx.at>

Datum:

19.05.2016 09:29:20

Dear Mr Lackenbauer, thank you for your inquiry.

We are a very young Bachelorstudiengang, because we started in autumn 2014. Therefore our students will first finish in summer 2017.

I am sorry, but I wish you an interesting time, a lot of support and staying power.

Best wishes

Heike Bauer-Horvath, MA

Studiengangsleiterin Physiotherapie

Fachhochschule Burgenland GmbH

Steinamangerstrasse 21, 7423 Pinkafeld

Tel.: +43 5 7705-4221, Mobil: +43 664 88328363

www.fh-burgenland.at

Appendix 15: E-mail correspondence with ENPHE member institutions.

RE: Case management survey European undergraduate physiotherapy students

Von:

"Pablo Herrero" <pherrero@usj.es>

An:

"Wolfgang Lackenbauer" <wolfgang.lackenbauer@gmx.at>

Datum:

14.04.2016 05:45:30

I will be pleased to help, the only thing is that I can't promise how many of them are going to participate, but I will send to all of them (besides because when it is in English they don't like too much in some cases but we will try)

I hope your work is going well

Regards

Dr. Pablo Herrero Gallego

Vicedecano de Fisioterapia

Vice-Dean Physiotherapy Degree

Campus Universitario Villanueva de Gállego

Autovía A-23 Zaragoza-Huesca Km. 299

50.830 - Villanueva de Gállego (Zaragoza)

Tel.: (+34) 976 060 100 Fax.: 976 077 581

Móvil: (+34) 608 566 215

Appendix 16: Identical answers by students from one ENPHE member country.

Case 1	Case 5	Case 8	Case 9	Case 12
Keep and Refer	Refer	Refer	Keep and Refer	Refer
Keep and Refer	Refer	Refer	Keep	Refer
Keep and Refer	Refer	Refer	Keep and Refer	Refer
Keep and Refer	Refer	Refer	Keep and Refer	Refer

Appendix 17: Feedback example from the supervisory team.

Keep/refer decision making abilities as part of the physiotherapeutic education and profession in Austria

General questions

Medical specialisation: GP

Orthopaedic Surgery

Years of Experience (after finishing clinical specialisation): 0-5; 5-10; 11-20; >21

Referrals to Physiotherapy/year: 0-20; 21-50; 51-100; > 101

Questions concerning physiotherapeutic under- and postgraduate education in Austria

Do you personally believe that keep/refer decision making abilities should be an integral part of the physiotherapeutic undergraduate education in Austria?

Yes/no

How important do you think is that physiotherapists screen patients for signs and symptoms of possible serious medical pathologies as part of their routine physical assessment?

Very little not at all cannot say

Do you think that physiotherapists should consider various organ systems as possible causes of pain as part of their clinical decision making processes?

very little not at all cannot say

Do you think that physiotherapists should consider various organ systems as possible causes of pain as part of their clinical decision making processes?

Yes/no

Do physiotherapists (on a regular basis) contact you because of worrying or even alarming peculiarities/changes in their patients' health status?

[An open ended question asking about what type of things physios refer or miss could be interesting](#)

Yes/no

If the answers is yes:

How important is this sort of feedback for your own further clinical decision making process?

Very little not important cannot say

Appendix 18: Final version of the questionnaire for Austrian medical doctors after feedback from the supervisory team.

General questions

Referrals to Physiotherapy/year:

0-20 ☐

21-50 ☐

51-100 ☐

>100 ☐

Questions concerning physiotherapeutic under- and postgraduate education in Austria

Do you personally believe that keep/refer decision making abilities should be an integral part of the physiotherapeutic undergraduate education in Austria?

Yes/no

Do you personally believe that every qualified physiotherapist should be capable of making a correct keep/refer decision?

Yes/no

Do you personally believe that keep/refer decision making abilities should be an integral part of every physiotherapist's continuous, postgraduate education?

Yes/no

How important do you think is that physiotherapists screen patients (in conjunction with the doctor's examination) for signs and symptoms of possible serious medical pathologies as part of their routine physical assessment?

Very little not at all cannot say

Which of the following examination techniques should every qualified physiotherapist be capable of (Multiple answers possible):

- Neurological Examination (power, sensation, reflex) of the peripheral nerves (upper and lower extremities).
- Palpation of the peripheral pulses (upper and lower extremities).
- Clinical examination of the cranial nerves.
- Palpation of organs such as spleen, liver, kidneys (cause of pain and ab/-normal extension).
- Kidney percussion test.
- Palpation of lymph nodes (cause of pain and ab/-normal size).
- Auscultation of the heart, lungs and abdominal region.
- Taking blood pressure.

Questions regarding your everyday work

Do physiotherapists (on a regular basis) contact you because of worrying or even alarming peculiarities/changes in their patients' health status?

Yes/no

If the answer is yes:

How important is this sort of feedback for your own further clinical decision making process?

Very little not important cannot say

Have physiotherapists (you are working with) ever missed a serious medical diagnosis?

Yes/No

If the answer is yes:

Please state which one: _____

Thank you for your time

Appendix 19: Final (amended) version of the questionnaire for Austrian medical doctors after feedback from volunteering Austrian medical doctors.

General questions

Referrals to Physiotherapy/year:

0-20 ☐

21-50 ☐

51-100 ☐

>100 ☐

Questions concerning physiotherapeutic under- and postgraduate education in Austria

Do you personally believe that every qualified physiotherapist should be capable of making a correct keep/refer decision?

Yes/no

Do you personally believe that keep/refer decision making abilities should be an integral part of the physiotherapeutic undergraduate education in Austria?

Yes/no

Do you personally believe that keep/refer decision making abilities should be an integral part of every physiotherapist's continuous, postgraduate education?

Yes/no

How important do you think is that physiotherapists screen patients (in conjunction with the doctor's examination) for signs and symptoms of possible serious medical pathologies as part of their routine physical assessment?

Very little not at all cannot say

Which of the following examination techniques should every qualified physiotherapist be capable of (Multiple answers possible):

- Neurological Examination (power, sensation, reflex) of the peripheral nerves (upper and lower extremities).
- Palpation of the peripheral pulses (upper and lower extremities).

- Clinical examination of the cranial nerves.
- Palpation of organs such as spleen, liver, kidneys (cause of pain and ab/-normal extension).
- Kidney percussion test.
- Palpation of lymph nodes (cause of pain and ab/-normal size).
- Blood pressure, pulse, temperature, oxygen saturation.

Questions regarding your everyday work

Do physiotherapists (on a regular basis) contact you because of worrying or even alarming peculiarities/changes in their patients' health status?

Yes/no

If the answer is yes:

How important is this sort of feedback for your own further clinical decision making process?

Very little not important cannot say

Have physiotherapists (you are working with) ever missed a serious medical diagnosis?

Yes/No

If the answer is yes:

Please state which one: _____

Thank you for your time

Appendix 20: Study description for medical doctors in Austria.



Date 05.09.2017
Wolfgang Lackenbauer
Course: PhD
Department Health, Psychology and Social Care
Brooks Building
Manchester Metropolitan University
Tel:

Study Description / Information Sheet for Medical Doctors in Austria.

Name of the Researchers:

Wolfgang Lackenbauer (wolfgang.lackenbauer@stu.mmu.ac.uk)

Prof James Selfe (J.selfe@mmu.ac.uk)

Dr Jessie Janssen (JJanssen@uclan.ac.uk)

Dr Hazel Roddam (hroddam@uclan.ac.uk)

Background of the study

Keep/refer decision making abilities are not intended to interfere with or replace a definite medical diagnosis by medical doctors. This has always been, is, and will remain solely the responsibility of members of the medical profession.

However, the European and World-Wide Guidelines for the Physiotherapeutic Education and Profession clearly point out that physiotherapists must be capable of independently making a correct decision, whether a patient (based on his clinical presentation and certain signs and symptoms) is suitable for physiotherapy intervention (keep) or should rather be referred (back) for further medical evaluation and/or treatment (refer) (WCPT 2011; ER-WCPT 2008).

Aim of the study

The following questionnaire is part of an ongoing dissertation. Its intention is to get proper insight into the importance of keep/refer decision making abilities as part of the physiotherapeutic education and profession from the perspective of Medical Doctors in Austria.

Why have you been chosen?

You have been chosen because you are a General Practitioner or Orthopedic Surgeon working in private practice in Austria. Research has shown that the majority of referrals to physiotherapy come from General Practitioners and Orthopedic Surgeons (Knipp 2008).

What will you be asked to do?

You will be asked to fill in an online questionnaire.

Once you have received the link you will have two weeks to participate. After this time it will not be possible to participate anymore.

By completing the online questionnaire, you are automatically consenting to the study.

What happens when the study stops?

After you have completed this one questionnaire, you will not be contacted or required to participate in an additional questionnaire related to this project.

Confidentiality

Unique identifier codes, which consist of numbers (and/or letters), will be automatically generated for each subject by the online survey tool (Bristol online survey tool). These codes (Token) will allow tracking which subjects completed the survey and ensure that reminder mails will only be sent to those who have not already completed the survey. These codes will be immediately and permanently deleted once a survey has been received by the researcher. Deletion of these codes will make it impossible to trace back a questionnaire to individual respondents.

The questionnaires will be stored on a password-protected device and kept securely in a locked cupboard.

What are the possible disadvantages or risks of taking part?

This is a low risk study where you are solely asked to fill in an online questionnaire.

What will happen to the results of the study?

Results of the study will be used by the main investigator for his dissertation and publication in a peer-reviewed journal.

The results will only be accessible to the main investigator (Wolfgang Lackenbauer) and the supervisor team.

Who has reviewed the study?

The study has been approved by the ethics committee at Manchester Metropolitan University/UK.

Who is organizing the study?

This study is part of an on-going dissertation by the main investigator (Wolfgang Lackenbauer) who is studying at Manchester Metropolitan University.

Do you need to take part?

Participation is completely voluntary and you have the right to refuse to participate and withdraw without any consequences (without the need to give any reason). Withdrawal from the study is possible before and after the completion of the questionnaire. However, once the document has been sent back and the codes (Tokens) are removed, withdrawal is not possible anymore.

What if there is a problem?

If you have a concern about any aspect of this study, you should ask to speak to Wolfgang Lackenbauer (wlackebauer@uclan.ac.uk) who will do his best to answer your questions. If you still remain unhappy and wish to complain formally, you can do this by emailing the research supervisor Prof James Selfe (j.selfe@mmu.ac.uk).

Appendix 21: Information sheet for prospective study participants.



Date 06.06.2016

Name Wolfgang Lackenbauer

Course PhD via MPhil

Department Health, Psychology and Social Care

Brooks Building

Manchester Metropolitan University

Tel:

Information Sheet for Austrian Universities (phase two).

Name of the Researchers:

Wolfgang Lackenbauer (wolfgang.lackenbauer@stu.mmu.ac.uk)

Prof James Selfe (J.selfe@mmu.ac.uk)

Dr Jessie Janssen (JJanssen@uclan.ac.uk)

Dr Hazel Roddam (hroddam@uclan.ac.uk)

Background of the study

Recognition of serious pathologies of the neuro-musculoskeletal system, especially in the early stages, is a major challenge for all clinicians. Despite the fact that not all physiotherapists in Europe work in a direct access health care setting (physiotherapy without medical referral), research has shown that physiotherapists (in both direct and non-direct access systems), when using proper screening strategies, can become crucial when it comes to recognizing underlying systemic diseases and various disorders where immediate medical attention is warranted. Therefore, it is crucial that every qualified physiotherapist and physiotherapy student working with patients receives a certain level of education in order to be capable of making an accurate decision if a patient seems suitable for physiotherapeutic management (keep), or not (refer).

Aim of the study

This study aims at establishing longstanding resources as viable and educationally useful teaching assets for the future development of keep/refer decision making abilities of Austrian undergraduate physiotherapy students.

An additional questionnaire aims at getting a better understanding of the importance of keep/refer decision making abilities from the student's point of view.

Confidentiality

Both the survey and the questionnaire will be confidential and anonymous so that you will remain completely unidentifiable.

Both the survey and the questionnaire will be stored on an encrypted/password-protected device which will be kept securely in a locked cupboard.

Results from the project will solely be used by the main investigator for his dissertation and publication in a peer-reviewed journal.

The results of the study will only be accessible to the main investigator (Wolfgang Lackenbauer) and the supervisor team.

Procedures

Participating students will be randomly allocated to either an intervention group or a control group. The intervention group will receive a lecture summarizing various resources about the recognition of possible red flag pathologies. Subsequently, both groups will be given a survey containing descriptions of validated cases in order to assess whether the lecture had a positive effect on the keep/refer decision making abilities of final year Austrian undergraduate physiotherapy students.

Time frame

The intervention (lecture) will take no more than 2 hours. Completion of the survey will take 14 minutes. The control group will be asked to complete the survey after the completion of the randomisation process. Completion of the survey by the intervention group will take place immediately after the lecture.

Do the students need to take part in the study?

Students have the right to refuse participation and withdraw (without the need to give any reason) without any consequences. Withdrawal from the study is possible after random allocation, after the execution of the intervention (if they are in the intervention group) and immediately after the completion of the survey and/or questionnaire. However, once the documents have been handed in, withdrawal is not possible anymore (since the documents are anonymous).

Further Information

You may ask any question related to the project at any time of the study. You can discuss/express your questions/concerns personally/face to face with the main investigator (Wolfgang Lackenbauer), or you can contact the Director of Studies Professor James Selfe under:

J.selfe@mmu.ac.uk

Appendix 22: Informed consent form for participating students.



Date 06.06.2016
Wolfgang Lackenbauer
Course PhD via MPhil
Department Health, Psychology and Social Care
Brooks Building
Manchester Metropolitan University
Tel:

Consent Form

Study Description and Informed Consent for Austrian physiotherapy students (phase two).

Name of the Researchers:

Wolfgang Lackenbauer (wolfgang.lackenbauer@stu.mmu.ac.uk)

Prof James Selfe (J.selfe@mmu.ac.uk)

Dr Jessie Janssen (JJanssen@uclan.ac.uk)

Dr Hazel Roddam (hroddam@uclan.ac.uk)

Background of the study

Recognition of serious pathologies of the neuro-musculoskeletal system, especially in the early stages, is a major challenge for all clinicians. Despite the fact that not all physiotherapists in Europe work in a direct access health care setting (physiotherapy without medical referral), research has shown that physiotherapists (in both direct and non-direct access systems), when using proper screening strategies, can become crucial when it comes to recognizing underlying systemic diseases and various disorders where immediate medical attention is warranted. Therefore, it is crucial that every qualified physiotherapist and physiotherapy student working

with patients receives a certain level of education in order to be capable of making an accurate decision if a patient seems suitable for physiotherapeutic management (keep), or not (refer).

Aim of the study

This study aims to establish a longstanding resource as a viable and educationally useful teaching asset for the future development of keep/refer decision making abilities of Austrian undergraduate physiotherapy students.

In addition the study aims at getting a better understanding about the importance of keep/refer decision making abilities from the student's perspective.

Why have you been chosen?

You have been chosen because you are a physiotherapy student (within 3 months of your graduation) currently studying at a University in Austria providing a Bachelor Degree in Physiotherapy.

What will you be asked to do?

Initially, all participating students will be randomly assigned to either an intervention or control group.

In order to assess the keep/refer decision making abilities you will be given 11 concise cases.

You have 3 answer options to choose from (only **one answer per case** possible):

- 1) Providing physiotherapy intervention **without** the need for additional medical evaluation and/or management (**PT only**).
- 2) Providing physiotherapy intervention **together with** medical evaluation and/or management (**PT plus MD**).
- 3) Referring the patient to a medical professional **without** physiotherapy intervention (**MD only**).

You have 14 minutes in order to individually complete the task.

It is fully acknowledged that in a real-life clinical setting, you would make more tests and have various additional opportunities for making a definite clinical decision. However, in order to make this survey feasible, the cases are intentionally kept short.

After having completed the survey, you will be asked to fill in a questionnaire.

What happens when the study stops?

After you have completed this one survey and questionnaire, you will not be contacted or required to participate in an additional survey and/or questionnaire related to this project.

Confidentiality

The survey and questionnaire will be confidential and anonymous so that you will remain completely unidentifiable.

The survey and questionnaire will be stored on a password-protected device and kept securely in a locked cupboard.

The results will only be accessible to the main investigator (Wolfgang Lackenbauer) and the supervisor team.

What are the possible disadvantages or risks of taking part?

This is a low risk study where you are solely asked to fill in a survey and a questionnaire. Therefore, no risks or disadvantages are to be expected.

What will happen to the results of the study?

Results of the study will be used for the main investigator's dissertation and for publication in a peer-reviewed journal.

Who has reviewed the study?

The study has been approved by the ethics committee (STEMH) at the University of Central Lancashire in Preston/UK.

Who is organizing the study?

This study is part of an on-going dissertation by the main investigator (Wolfgang Lackenbauer) who is studying at the Manchester Metropolitan University/UK.

Do you need to take part in the study?

You have the right to refuse participation and withdraw (without the need to give any reason) without any consequences. Withdrawal from the study is possible after random allocation, after the execution of the intervention (if you are in the intervention group) and immediately after the completion of the survey and/or questionnaire. However, once the documents have been handed in, withdrawal is not possible anymore (since the documents are anonymous).

What if there is a problem?

You may ask any question related to the project at any time of the study. You can discuss/express your questions/concerns personally/face to face, or you can contact:

Wolfgang.lackenbauer@stu.mmu.ac.uk

If you still remain unhappy and wish to complain formally, you can do this by emailing the research supervisor Prof James Selfe (j.selfe@mmu.ac.uk).

Please initial box		
1. I confirm that I have read and understood the information sheet dated for the above project and have had the opportunity to ask questions about the interview procedure.		<input type="checkbox"/>
2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason to the named researcher.		<input type="checkbox"/>
3. I understand that my responses will remain anonymous.		<input type="checkbox"/>
4. I agree to take part in the above research project.		<input type="checkbox"/>
_____	_____	

Name of Participant	Date	Signature
_____	_____	

Researcher	Date	Signature
<i>To be signed and dated in presence of the participant</i>		

Appendix 23: CBL educational intervention (English version).

Differential Diagnostics/ Red Flag Screening in Physiotherapy

Wolfgang Lackenbauer, PT, MManip Th,
PhD candidate Manchester
Metropolitan University

Procedure/structure of the intervention/lecture

Case-based learning/teaching

- Theoretical background (basics).
- Case studies (in-depth/practical application).

Differential Diagnostics/Red Flag Screening in Physiotherapy: Why?

- We treat patients with disorders of the neuro-musculoskeletal system.
- Question: Is the cause really in the musculoskeletal system?
- Even if the patient has previously been examined by a doctor, we cannot rule out the possibility that the complaints may be treatable.
- It is essential to rule out the possibility that a pathological process might (partly) cause the pain of the patient.

Differential Diagnostics/Red Flag Screening in Physiotherapy: Reason!

- It can take weeks between visiting the doctor and the first physiotherapist appointment.
- Therapy lasts for many weeks.
- During this time, symptoms can change.
- Physiotherapist may be confronted with a completely different situation than a doctor.

Difference between differential diagnosis and diagnosis

- We do not diagnose specific diseases of the body.
- We do not formulate a medical diagnosis.
- Diagnosis is the task of the physician.
- BUT we refer the patient back to the doctor if there is suspicion of a systemic pathology/pathological process.

Overview Pain Physiology

- Our organs are innervated (nociceptors).
- Potential causes of pain.
- Free nerve endings (nociceptors) in organs.
- Mechanical or chemical stimuli can activate these nociceptors.

General principles of investigation: Pain characteristics (not mechanical)

- Constant pain.
- Not influenceable by changing the body position.
- Pain can be influenced by digestion, food intake.
- Wave-like course.
- Crampy (lasts a few minutes).
- Mainly/exclusively present at night.
(Cave: acute complaints of the musculoskeletal system)

General principles of investigation

- Question: "How does the patient's discomfort worsen?"
- Are the complaints motion/movement-dependent?
- Are they affected by activities of the organs (bowel movements, after/before eating, digestion, etc.)?
- Complaints of the musculoskeletal system should be either improved or worsened by changes in body positions (movements, postures)!!

Pain Characteristics: Summary

- Complaints of the neuro-musculoskeletal system (musculoskeletal system) should be influenced by a change in the posture/position of the extremities.
- If the complaints do not change (no matter which position is taken), or if they are mainly present at rest, the therapist should at least consider the possibility of a pathological process as the cause of the complaints.

Triggers of complaints

Potentially mechanical

- Was there a mechanical trigger (accident etc.)?
- Fall, heavily lifted, unusually long car journey....
- Day after (unusually) heavy work.

Potentially organic

- Suddenly/slowly started.
- No cause at all (mechanically) known.

In addition

Occurrence (no mechanical trigger) of symptoms in several joints (possibly rheumatic cause?).

Associated Signs and Symptoms

= additional symptoms and signs (from the anamnesis), which may indicate a possible pathological process.

Infection/Neoplasms

- Chills.
- Nausea.
- Fever (relapses).
- Fatigue... longer than 1-2 weeks.

lung diseases

- Possible cause of local pain in the thorax and thoracic spine area.
- Radiations into the shoulder and cervical spine possible!

Usually additional side effects:

- Hoarseness.
- Coughing.
- "Neck scratches".
- Shortness of breath.
- Whistling breath sounds (Stridor).

Pain characteristics: Cardio-vascular diseases

Coronary heart disease:

Tight feeling or pressure on the chest.
Shortness of breath.
Rapid fatigue.
Fainting spells (syncope).
Swelling in the legs (edema).

Complaints generally caused by physical exertion, but typically disappear comparatively quickly (when exertion is stopped).

Pain characteristics: Cardio-vascular diseases

Peripheral arterial occlusive diseases

- Frequently affected: older people and smokers! Buttocks / thighs / calf cramps or dull pulling.
- Pulse on the lower extremities weakened or completely absent.
- Reduced hair growth on the affected extremity. Tendency to skin ulcerations (ulcers).
- Nail dystrophies.

Complaints generally caused by physical exertion, but typically disappear comparatively quickly (when exertion is stopped). Cave: Spinal canal stenosis (change in symptoms due to spinal flexion???)

medical history

- Cancer in the past?
- High relapse rate!
- Other serious illnesses?
- Serious diseases in the family (genetic component)?
- -> cancer, vascular diseases, diabetes, kidney diseases....

Cancer Illnesses

- Cancer in the medical history only individual Red Flag with scientific basis.

Combination of different Red Flags:

- Patient older than 50 years.
- Cancer in the medical history.
- (unexplained) weight loss.
- No improvement through conservative therapy (within one month).

Medication

- Cause of various symptoms:
- Fatigue.
- Dizziness.
- Constipation / irregular digestion.
-

Important!!!

- I can't expect the patient to tell me everything automatically.
- I have to ask!
- Patients often see no connection between e.g. the lumbar spine complaints and the burning sensation when urinating.
- Often I only get the answers after I have specifically asked for them.

Physical Examination

Important point:

- Can my examination (active/passive movements, provocation tests, resistance tests, special tests, etc.) reproduce/improve/add/change the patient's complaints?

Be Careful!!!!

Reproduction of symptoms during the examination does not rule out a pathological process.

Example:

- - Movements/posture changes painful in case of e.g. infection of the discus intervertebralis or metastatic lesion.
- => Comparisons with other information from history, diseases, Associated Signs and Symptoms.....

Reproduction of symptoms: Osteoporotic fractures of the spine

4 characteristics:

- Age >70 years.
- Sex: female.
- Significant trauma (less trauma is sufficient for older people).
- Cortisone used for prolonged periods.

Palpation

- Abnormal size (>1 cm) of lymph nodes (infection, neoplasms).
- -> Axilla, femoral triangle, supraclavicular region, cervical spine (anterior/posterior).
- Bony (firm) and other soft tissue swellings.
- Abdominal wall (very firm and painful).

Course of therapy/treatment

Complaints do not get better (or even worse).

New symptoms are added (in the course of the therapy series).

Signs (asterisks, rediagnosis parameters) improve/change, but complaints/pain (of the patient) do not.

It does not always have to be the therapist's/therapist's fault!!!!

Leave the church in the village

- Just because a patient has a 'red flag' does not mean that a systemic pathology is the cause of his symptoms.
- A red flag is usually not so bad/relevant/expressive.
- Do not jump to conclusions.
- But it should increase my attention!
- Compare all information gained with each other and see what fits or doesn't fit, or whether the overall picture makes sense.
- Cluster of symptoms.
- How many potential 'red flags' are there in the patient?

Summary

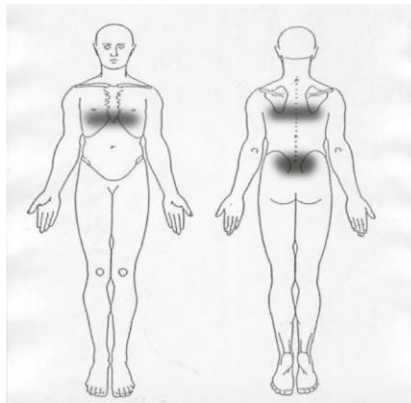
- It's not about replacing the doctor.
- It is neither our job nor our job description.
- Examination should not be unnecessarily prolonged by Red Flag screening (time factor).
- But: We should listen attentively, ask questions and observe.

Case 1

A 32-year-old patient (currently unemployed) comes to therapy with the medical diagnosis grade I spondylolisthesis L5/S1.

The patient has been suffering for a long time from recurrent lumbar spine complaints (mostly due to a lifting trauma).

No particular medical abnormalities (no smoking, no fever, no chills, no abnormalities in medical history, no medication).



Case 1

However, the patient's current main problem is not pain in the lumbar spine but intermittent, deep pain in the middle thoracic spine, which also radiates into the ribcage on both sides.

The complaints in the lumbar spine are also disturbing but by far not like those in the thoracic spine.

Case 1

The pain in BWS occurred 2 weeks ago after a physiotherapy session when the therapist tried a new joint mobilisation.

However, the pain did not occur immediately, but only a few hours later (in the evening).

According to the patients, the pain in the BWS cannot be attributed to a particular position/movement.

The pain comes and goes for no particular reason.

Case 1

Physical examination:

Increased BWS kyphosis and lumbar spine lordosis.

The pain in the thoracic spine can neither be provoked/triggered by active/passive movements nor during the manual examination of the thoracic spine.

Muscle tension in AOPD is considered normal.

Stiffness noticeable in middle AOPD (T5-T10) (active as well as in PAIVM).

Case 1

In addition:

The patient describes suffering from heartburn after eating for about 1-2 weeks.

However, the connection between heartburn and BWS pain is unclear for patients.

He took Motrin (Ibuprofen, NSDAR) for several months, but not for 2-3 weeks.

Case 1

Consultation with doctor, since the symptoms had developed only after the last visit to the doctor (the doctor therefore knew nothing of the BWS complaints). The doctor then prescribes Tagamet to the patient (reduces gastric acid secretion, among other things) and puts him on a diet (light food). 2 days later the complaints in the BWS are gone. But enough mechanical abnormalities in lumbar spine to find.

Case 1 retrospective

- BWS pain not mechanical (come and go).
- Not to attribute specific body position or movement.
- Nothing relevant found in physical examination.
- Heartburn for a short time and before that for a long time taking painkillers (increased risk of developing a stomach ulcer).
- Although before physician examination had taken place -> completely different situation than with the physician -> this knew nothing of new symptoms!

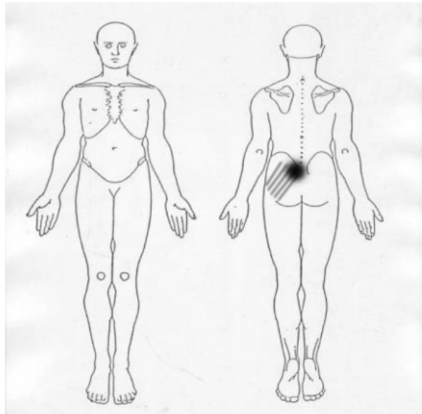
Case 2

A 39-year-old housewife comes to therapy with a diagnosis of mechanical lumbar spine pain with gluteal trigger points unilaterally on the left side.

The patient suffers from constant pain in the gluteal left side and intermittent stabbing pain in the left SIPS area.

The pain in the gluteal left side hardly changes but is slightly increased when a position (no matter which one) is taken for more than 30 minutes (patient must therefore constantly change position).

The pain in the SIPS is triggered immediately by weight transfer to the left leg (but also disappears after a few minutes when the patient lies down).



Case 2

The constant pain gluteal left occurred 10 weeks ago for the first time (creeping onset). The patients had similar complaints again and again in the last 2 years.

The intermittent pain in the area of the left SIPS for 3 weeks after a fall on the buttocks.

Patient history inconspicuous.
The patient takes painkillers.

Case 2

The patient has been suffering from constipation and an increased urge to urinate for 8 weeks.
The pain in the gluteal left side becomes worse at the same time as the constipation increases. A relief of the pain gluteal noticeable after bowel movement.

According to the patient, the doctor knows about constipation and increased urge to urinate.

Case 2

Physical examination

Immediate pain in the area of the left SIPS, if more weight (one-legged position) is placed on the left leg.

Increased muscle tone of the lumbar extensors and left buttock muscles.

Severe pain during palpation in the area of the joint space of the left ISG.

Active extension causes typical pain in the area of SIPS on the left.

Passive ISG provocation tests reproduce pain in SIPS.

Muscle shortening of the ischio-crural musculature on the left and the rectus femoris muscle on the left.

Case 2

course of treatment

Treatment of left ISG dysfunction immediately reduces pain in the left SIPS area during monopod and active extension.

In the following units, muscle shortening and muscle hardening are additionally treated.

After 2 weeks already 80% relief of the constant pain in the buttocks. SIPS pain at this time completely gone.

Constipation and increase in urine frequency also noticeably better.

Case 2

- After the following weekend the patient explains that the gluteal pain on the left, the constipation as well as the increased urge to urinate are the same as at the beginning of the treatment (on the day of the first examination).
- There was no accident, no trauma etc.
- Pain in the area of left SIPS still gone.
- Examination: No change in signs and symptoms (asterisks) since last treatment (as well as the pain gluteal left, the constipation and increased urination were already 80% better).

Case 2

- Examination by specialists (internists) recommended.
- Follow-up telephone call after 6 weeks: Ovarian cyst removed.
- Since then completely painless.

Case 2 retrospective

- 2 different symptoms: One clearly mechanical, the other less.
- Insidious onset of gluteal pain.
- Influenced by constipation.
- Additionally increased urge to urinate.
- Even if doctor knows!
- First improvement of the symptoms, then without obvious reason the same as on day 1.
- No change in the improvement (asterisk) through therapy, but the symptoms are much worse again.
- Discrepancy between the result of the physical examination and the patient's subjective complaints.

Case 3

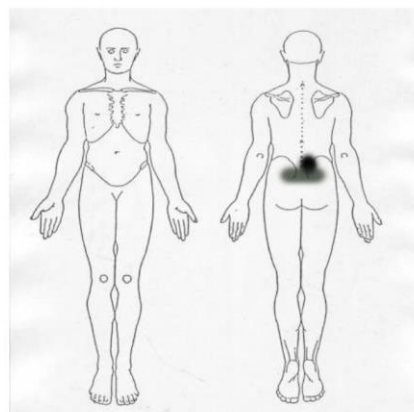
A 75 year old patient comes to therapy with a diagnosis of mechanical lumbar pain.

He complains of an intermittent, sharply stabbing pain in the right lumbar spine and a constant, throbbing pain in the lumbo-sacral transition.

The intermittent, stabbing pain is intensified by coughing, sneezing, bending over and transfers (while lying down turn around and sit->stand).

Taking a lying position is currently not possible -> Sleeping in a lounge chair.

The constant, throbbing pain is not influenced by any movement or change of posture.



Case 3

Beginning of intermittent stabbing pain 4 weeks ago shortly after fence posts were pulled out.

The constant throbbing pain began 1-2 days later. Both pains became steadily worse over the last 4 weeks.

Initial therapy (4 units with another therapist) consisted of "setting", heat packs and current therapy.

No improvement by these therapeutic measures.

Case 3

Patient has been suffering from lumbar spine pain attacks for 30 years (always caused by lifting and/or bending).

Usually the symptoms go away by themselves after a few days.

This time it takes much longer and the pain is more intense.

With earlier pain episodes, the pain could be alleviated by lying down.

Case 3

medical history

- - Hypertension.
- - Sugar.
- - Gastric tumour removed 1 year ago-> Next check-up in 6 months.
- -> Referring physician knows and would like to avoid unnecessary clarifications (e.g. radiological examinations) at present still, since the pain was released by a mechanical event and the patient knows such a thing for 30 years. But I would like to be informed at regular intervals and try a series of physiotherapy!

Case 3

Result of physical examination

Reduced lordosis lumbar spine.
Active extension triggers stabbing pain in the right lumbar spine.
Active lumbar spine flexion painfully restricted (particularly painful when straightening up again).
Active lateral flexion and rotation moderately painful on both sides.
Increased muscle tone of the erector spinae L2-S2 on both sides.
PAIVM right: L5 Reproduces stabbing pain of the lumbar spine.
General hypomobility of lumbar spine noticeable.
Vertical compression in sitting-> throbbing pain slightly increased.

Case 3

Therapy consisted of soft tissue techniques of lumbar extensors, manual traction and heat packs.
Corset was tried -> but did not bring any improvement.

After 3 sessions-> Intermittent, stabbing pain unilaterally right in lumbar spine practically gone.
However, a lying position is still impossible because of the constant, throbbing pain in the lumbo-sacral transition.

Case 3

During the 4th session: Severe swelling in both legs and feet noticed (according to patient has developed in the last 24 hours).

In addition, initiation of a bowel movement difficult possible.

Case 3

Doctor contacted immediately->

Results of medical examinations:

Several metastases and pathological fractures in the costal arch, BWS and lumbar spine including L5.

Case 3 retrospective

Trigger mechanical (typical for patients).
For 30 years pain episodes.
May last longer than 4 weeks-> not uncommon in older patients with wear and tear.
Mechanically triggerable (patient gives very clear positions) and also reproducible (at least partially!) during the examination.

BUT:
Cancer in the near past (!).
Pounding pain in the lumbo-sacral transition unchanged due to change of posture or movements.
Current episode different (stronger, worse, longer lasting) than in the past!
Therapy already nothing helped-> not always only therapy wrong! Pain was not better (would be normal) but worse.
Pounding pain prevents rest position (?)> in the first days okay, but after 4 weeks?
Metastatic lesions influence surrounding tissue (e.g. fractures)-> mechanical pain!

A little tip

- Every patient is potentially suspicious!
- Always remain critical and curious!
- Do not exclude anything from the outset!
- Always remain suspicious and attentive during the entire examination and therapy!
- Countless case studies in the literature excellent reading and learning materials!
- Medical screening not only part of the initial findings (should be carried out regularly in the course of the therapy series).

References

The information comes exclusively from the following sources:

- Boissonnault, W. G., Bass, C. (1990) *Pathological Origins of Trunk and Neck Pain: Part I- Pelvic and Abdominal Visceral Disorders*. JOSPT 12:5; pp. 192-207.
- Boissonnault, W. G., Bass, C. (1990) *Pathological Origins of Trunk and Neck Pain: Part II- Disorders of the Cardiovascular and Pulmonary Systems*. JOSPT 12:5; pp. 208-215.
- Boissonnault, W. G., Bass, C. (1990) *Pathological Origins of Trunk and Neck Pain: Part III- Diseases of the Musculoskeletal System*. JOSPT 12:5; pp. 216-221.
- Henschke, N., Maher, C.G., Ostelo, R. W. J. G., de Vet, H. C. W., Macaskill, P., Irwig, L. (2013) 'Red Flags to screen for malignancy in patients with low-back pain (Review)'. *Cochrane Database of Systematic Reviews*, 2:CD008686, pp. 1-29. [Online] [Accessed on 3rd October 2016] DOI: 10.1002/14651858.CD008686.pub2.
- Williams, C.M., Henschke, N., Maher, C.G., van Tulder, M.W., Koes, B.W., Macaskill, P., Irwig, L. (2013) 'Red Flags to screen for vertebral fracture in patients with low-back pain (Review)'. *Cochrane Database of Systematic Reviews*, 1: CD008643, pp. 1-38. [Online] [Accessed on 3rd October 2016] DOI: 10.1002/14651858.CD008643.pub2.

Appendix 24: Supplementary questionnaire for all students.

1. Questions about the survey

1.1 How difficult was it for you (in general) to complete the survey?

Difficult average easy unsure
☐ ☐ ☐ ☐

1.2 What did you personally find most difficult when making a keep/refer decision (and can you tell us why)?

1.3 Were the 11 cases familiar to you?

Yes ☐
No ☐
Cannot say ☐

2. Questions about teaching keep/refer decision making abilities

2.1 How do you personally think can keep/refer decision making abilities be improved?

The following questions are for students from the intervention group only:

2.2 Were you generally satisfied with the intervention (lecture)?

Yes ☐
No ☐
Cannot say ☐

2.3 Do you personally feel that the additional lecture was helpful for you to make an accurate keep/refer decision (based on the 11 vignettes)?

Yes ☐
No ☐
Unsure ☐

2.4 Which part(s) of the additional lecture did you personally find most beneficial to help you to make an accurate keep/refer decision (based on the 11 vignettes)?

The theoretical background ☐
The additional cases ☐

Both ☐

Please state why: _____

2.5 Do you personally feel that the intervention (lecture) was too time consuming?

Yes ☐

No ☐

Cannot say ☐

2.6 Do you personally feel that the lecture was lacking something (which should be included in future lectures)?

Appendix 25: 11 validated vignettes by Mount (2012).

Type	Case	Description
Traditional		
	3	<i>A 60-year-old male is admitted to a skilled nursing facility following a cerebrovascular accident with right-sided hemiplegia five days earlier. His past medical history is significant for hypertension, type two diabetes mellitus, and gallbladder surgery. He is having difficulty performing transfers and maintaining his sitting balance. He complains of dizziness with transfers but it dissipates quickly. He is lethargic and fatigues quickly.</i>
	5	<i>A 79-year-old male with a history of coronary artery disease, chronic obstructive pulmonary disease, chronic renal insufficiency and a right transfemoral amputation is seen in physical therapy with balance and ambulation difficulty. He has been ambulating with a rolling walker and a prosthesis for several years but his wife reports that his activity level has declined significantly over the past six months. He has had frequent falls and complains of mild shortness of breath with activity.</i>
	8	<i>A 53-year-old woman with a fairly sedentary lifestyle complains of a recent onset of deep, dull, aching pain in the posterior cervical and interscapular region of her upper back. The pain began after she slipped off a curb and nearly fell. She has tenderness in her upper trapezius muscle and she states she has pain when raising her arm and turning her head. Pain is intermittent and is relieved when she lies down. She demonstrates no motor or sensory loss.</i>
Non critical		
	2	<i>A 40-year-old female with a history of spina bifida who lives alone is referred to home health physical therapy for treatment of a sacral wound following an acute care stay. The physician has continued the intravenous antibiotics. She reports severe pain with sitting and is having difficulty with transfers. Her wound has moderate serosanguinous drainage, a strong odor and yellow exudate.</i>
	9	<i>A 43-year-old female is seeking physical therapy for non-operative treatment of a right shoulder rotator cuff tear that occurred after a recent fall. She complains of pain during right shoulder elevation and an inability to lift her arm over her head. While reviewing her medical history, she mentions the development of a cough over the past few days along with a low-grade fever. She is being treated for melanoma that was diagnosed 4 months ago in the right cervical lymph nodes and has been receiving biochemotherapy for the past 3 months.</i>
	10	<i>A 46-year-old female with a history of irritable bowel syndrome and ovarian cysts complains of low back pain. It has bothered her on and off for about one year for no apparent reason. The low back pain varies and worsens with lifting and prolonged standing. It is intermittent, does not radiate and is relieved with rest. She mentions that she has had pain, occasional bloating and a sense of heaviness in the pelvic/ abdominal region for the past few months.</i>
	11	<i>A 75-year-old female was referred to home health physical therapy following an open reduction internal fixation of the left ankle from a fall five days ago. She is non-weight bearing but is able to transfer in and out of a wheelchair independently and propel it short distances. She complains of a chronic non-productive cough over the past several years that seems to be worsening and a recent onset of increased shortness of breath since her injury. She notes that she has taken several types of medications during the past year due to repeated respiratory tract infections.</i>

Critical Medical		
	1	<i>A 65-year-old obese male is admitted to the hospital with pneumonia. Physical therapy is consulted to assist with ambulation. He reports having fever and chills for several weeks along with muscle and joint pain, especially his knees. During your examination he complains of a stiff neck and difficulty concentrating. He reports he is not sleeping well which he attributes to his muscle and neck pain. You also notice a rash on the back of his leg.</i>
	4	<i>A 42-year-old male was involved in a motor vehicle accident last night when he was hit in the driver's side of his vehicle. He suffered a non-displaced left tibia/fibula fracture and was casted. Physical therapy was consulted to assist with non-weight bearing ambulation but he is apprehensive because he reports constant severe left shoulder pain. It started this morning when he awoke. He describes the pain as a sharp, deep ache over the upper trapezius and shoulder. He demonstrates no loss of passive motion and is able to tolerate active and resisted motions without any change in pain.</i>
	6	<i>An 18-year-old male suffered an incomplete C6 spinal cord injury due to MVA. The patient was treated in the hospital for 2 months and once stabilized was transferred to a rehabilitation facility. He has been in the facility for several weeks. During his am therapy session, you notice unilateral swelling (1 inch greater than right) and warmth of his left lower extremity. The swelling did not improve with elevation.</i>
	7	<i>An 80-year-old active but frail woman fell on a rug in her apartment and landed on her outstretched hands. She complains of tenderness over the lateral aspect of the right wrist and distal forearm, and a bony deformity is palpable. Her wrist is swollen and painful, with decreased range of motion.</i>

Appendix 26: Slips of paper for the randomisation process.



Appendix 27: Raw data for the question: What did you personally find most difficult when making a keep/refer decision (and can you tell us why)?

Categories that emerged out of the data which are relevant for the research question:

Yellow: additional information needed in cases.

Pink: understanding/ interpretation of complex cases

Blue: physiotherapy is almost always indicated.

Green: Difference between PT+MD and only MD.

Camouflage: When to consult an MD.

Red: Lack of experience/knowledge.

Grey: *Not relevant for research question.*

Intervention group FH Vienna

1. Being unable to obtain additional information (typical for cases).
2. It was not difficult to decide whether physiotherapy was indicated. Physiotherapy is almost always indicated (when properly executed) when something is wrong with the musculoskeletal system. It was rather difficult to decide whether a medical referral was necessary.
3. Properly assess additional symptoms. Making connections between internal and musculoskeletal problems-> do they influence each other? It was difficult to assess how serious additional symptoms were.
4. To filter out relevant information. Interpretation of the information that was given.
5. Most difficult: You were not given the possibility to firstly send the patient to a physician but because of problem B, you could continue the physiotherapy intervention, however only after the medical check-up.
6. Physiotherapy management can be diverse (manual therapy or relaxation). Hence, it can be done most of the time.
7. The question if physiotherapy is generally indicated or just in this one particular moment.
8. Very little experience (do the symptoms fit a particular disease).
9. Inability to obtain additional information for confirmation.
10. Not enough information. Some problems within a case seemed relevant for physiotherapy, while others (in my opinion) required medical attention.
11. Many different symptoms combined.
12. Unsure if symptoms were really warning signs when I chose "only MD". I just wanted to be safe.

13. Unsure if important information was being missed (one that was an obvious sign). Probably because the current lack of practice and experience.

14. Not enough additional information. E.g. in case 11-> Has the shortness of breath already been seen by a physician.

15. Personally: Not enough information.

16. Lack of information concerning previous medical investigation(s).

17. In many cases, I had the feeling I should rather (to be safe) consult a physician. I was sometimes not confident enough to only choose PT. I was unsure because of the many diagnoses and the different causes/possibilities of the patients' pain.

18. /

19. Especially difficult to decide when Pt is sufficient-> maybe after a couple of therapy sessions a medical examination would have then been necessary.

20. Would have been easier to examine the patient (to get the whole picture).

21. To choose between PT and PT+MD.

Control group FH Vienna

1. I do not know all red flags for individual pathologies. Lack of experience.

2. Difficult to determine if symptoms might be a contraindication.

3. Paper based case itself. Cannot see the real person/client-> when e.g. in pain, facial expression absent in a paper based case. Little experience in dealing with certain diseases. Therefore I often chose additional referral to an MD.

4. Multi morbidity-> when not only the musculoskeletal system was affected but also the organ system as well. I was unsure if an additional medical check-up was necessary.

5. Without being able to do a patient interview (anamneses), it is impossible to ask additional questions and obtain information which might be helpful. In the case of some symptoms (e.g. shortness of breath, bloating, feeling of heaviness), it was not clear if maybe something sinister might be the reason for them.

6. Which extent of symptoms (coughing seizures, pain, malignancy) requires immediate medical referral.

7. Multi morbidity of patients.

8. It was not clear if therapist can freely decide which intervention he or she would choose. E.g. in the case of fever, PT should not be made but relaxation might be possible.

9. I was quite often indecisive whether to consult an MD or not, however, when I was not sure I decided to either choose PT+MD or only MD.

10. Since here in Austria, there is always a physician who examines the patient prior to physiotherapy, we never really learn how to make such decisions.

11. I could not remember all yellow flags. In general, the whole picture about the yellow flags is missing as they were purely discussed within very specific lectures.
12. /
13. I was unsure, when a symptom did not occur exactly at the place for which the patient has been referred to physiotherapy, whether I should refer the patient immediately or later.
14. Lack of time and additional information (patient interview e.g.) in order to be able to exclude more properly.
15. Not so much the decision itself; rather that I would have (in some cases) referred the patient to a physician prior to the start of my intervention.
16. For me personally, it was difficult to distinguish between PT+MD or simply MD.
17. Lack of knowledge about red flags and contraindications. It is not possible to test hypotheses when dealing with cases.
18. Signs and symptoms which I could not relate to any specific medical condition.
19. Lack of experience.

Intervention group FH Kärnten

1. Difficult when the information how much a MD knows or if the patient has consulted a MD is missing. Sometimes no definitive signs.
2. The decision when only a MD or only PT is indicated. When dealing with paper based cases, I am not able to wait and see how things develop; instead I need to make the decision immediately.
3. When symptoms get worse – because something could be changed, however, mechanical and “not mechanical” (cough) influenced.
4. If other symptoms (non mechanical) have a correlation with physiotherapy, or not. If other symptoms might be the cause of the main problem.
5. /
6. /
7. The medical condition/presentation was very diverse (a lot is possible or maybe not). Connections.

Control group FH Kärnten

1. The decision if medical attention was really necessary. Even if there are rather “small issues”, which I cannot influence as a physiotherapist, I prefer to refer the patient to a MD.
2. More information to make a definitive decision. Sometimes no definitive red flags. You are allowed to treat but also need additional investigation just to be safe.
3. If it is not simply enough to get the opinion from a MD but also continue physiotherapy, especially when symptoms occur in other body regions.

4. Having the responsibility to make the final decision that something might happen to the patient when I do not refer to a MD.
5. Making the decision between PT+MD (to be safe) or just PT-> probably depends on how much experience someone has. How much responsibility should a physiotherapist take.
6. It was more difficult to decide if a referral was necessary; especially when there were cases when you might assume that there is medical attention anyway.
7. Because PT in the form of e.g. respiratory therapy is indicated, eventhough for case nr. 9 I chose only MD as this was, in my opinion, the best solution.
8. /

Intervention group FH Sbg

1. /
2. Most difficult part was when physiotherapy seemed indicated but there was an additional issue/symptom which did not fit the clinical picture.
3. To identify a problem that can be purely influenced by physiotherapy. A problem that does definitely not negatively influence another one.
4. That the reason why I chose physiotherapy was not the same why I referred the patient to a MD. Information was missing which was necessary before making a final decision.

Control group FH Sbg

1. Two different problems at the same time-> this made it difficult to assess the relevance of the additional diagnosis. Little information in general (paper bases case)-> difficult to come to a decision when I have not actually seen/met the person.
2. The decision if prior medical check-up was necessary. The decision if additional diseases/signs and symptoms were a limiting factor for my therapy.
3. Lack of information. If respiratory therapy / (?) count as physiotherapy.
4. The combination of several internal problems.

Intervention group FH Graz

1. Multi morbidity. IN some cases it was hard to make a decision to start a treatment even before another problem has been sufficiently examined.
2. There were so many unanswered questions which cannot be fully answered with such a short vignette.

3. More specific information would be helpful; with a therapy setting you would ask further questions.
4. Especially when there were many additional diseases within a case. In these situations I asked myself the question if they require further medical check-up, even though they did not seem directly related to the referral diagnosis.
5. Imagination of the real patient. How to weight individual factors.
6. The decision if my arguments were firm/solid enough for referring the patient back to the MD.
7. Additional diseases. Contraindications.

Control group FH Graz

1. Determine when a referral to a MD is necessary; in how far the knowledge of a physio is to make such a decision.
2. I did not personally see the patient and could not ask him additional questions. In some cases there were situations which I have no experience with.
3. If there have already been sufficient medical investigations which allow a safe physiotherapy management. Sometimes very little information about which medical examination procedures have already been conducted (x-ray, orthopaedic assessment....in these current situations).
4. How safe it my therapy, can I make things worse, are there contraindications which I cannot assess adequately; based on which problem should a patient be referred to physiotherapy?
5. I did not know if there has already been a medical examination for e.g. shortness of breath and if the patient already receives treatment for this.
6. Recognise clues for red flag pathologies if a therapy might harm a patient or if prior medical evaluation is necessary.
7. Despite the history and the patient's symptoms- am I able reduce the patient's suffering-> I was uncertain if alternative treatment might cause more or less harm.
8. The most difficult part was to choose between PT+MD or only MD. Only PT was more conclusive as I did not expect something sinister and I did not want to look further. The decision if my therapy (until the medical examination has been complete) might do any harm was more difficult.

Interventiongroup FH Steyr

1. Pathological conditions due to varying symptoms difficult to assess if PT is indicated or not.
2. Most difficult part was to determine if there was a visceral involvement (due to lack of experience).
3. Interpretation of symptoms was difficult in some cases.
4. Lack of practical experience. Unsure if information was relevant or not,
5. No professional experience so far. Connected thinking difficult.

Controlgroup FH Steyr

1. Decision difficult as MD decides if physio indicated or not.
2. In how far is patient in ongoing GP care; or does PT+MD/ only MD mean that due to new symptoms the referring physician needs to be contacted; does only MD mean that physio is generally contraindicated?
3. How much medical check up has already been done (e.g. patient in hospital and then referral to PT).
4. How acute is the problem? First PT and then subsequent referral to MD? Or immediate referral to MD?

Interventiongroup FH Wels

1. Decisions under time pressure. Lack of information (e.g. examination).
2. When there was fever/ inflammation. When symptom increase was an issue.
3. Reasons that were for or against indication of physio was not always clear.
4. If it is necessary to bother the physician or if new/other symptoms are normal and not dangerous.
5. Little information about referral diagnosis.
6. When complaints that make me suspicious are not for my treatment-> still they need attention.
7. When referral because of different problem and not the acute one-> is treatment allowed? (e.g. case 4). Physio is always indicated.
8. Lack of additional info (examination, anamnesis,...). Assessment of relevance of certain info. How much attention do I pay these warning signs.
9. No "picture" to the patient.
10. In how far long existing diagnosis affects patient right now.
11. /
12. When there is good contact to treating physician, I would ask faster for further examination. More background information helpful (hence uncertainty when answering).
13. Little Information.
14. Not enough info in cases. Extramural setting.

Controlgroup FH Wels

1. What is the degree of risk when I choose PT plus concurrent medical referral (meaning: MD referral is indicated but am I still allowed to do cautious PT).
2. Nothing, as similar cases have been discussed during classes and similar cases have been treated during placement (in case of an indication).
3. Interpretation of symptoms such as fatigue and skin rash (symptoms not connected to specific disease).
4. Diffuse clinical picture. Pending medical check up. Red Flags such as night pain, cancer in HX etc.

5. Distinction between PT+MD and only MD, as you will still get the medical investigation but in the mean time you may be able to perform PT but with less intensity or if hand off is better before a MD has looked at the patient.
6. Physiotherapeutic relevance is often there; if physician is really necessary when there is no clear contraindication; When do I NOT need him?.
7. Difficult if in addition to PT should there be concurrent medical check up, as possible internal diseases or wound healing disorder which require rest which are difficult to detect.
8. Current level of knowledge-> possibly missing certain red and yellow flags.
9. In my opinion, PT is always indicated but you need to determine if concurrent medical check up is necessary.
10. Decision of patient needs to be send to a MD, or not. In Austria, patients will always have prior medical investigations and therefore physios are safe.
11. When there are no clear read flags-which have been discussed during the undergraduate time.
12. Not if PT is indicated or not but if there is the need for medical referral as physiotherapy is indicated in most cases.
13. When there is already a medical diagnosis and the physician has already done his/her investigation; my question is when referral back again to MD.
14. Not difficult to decide when PT is indicated but more difficult to determine when medical investigation is necessary prior to PT.
15. Little information and details about possible contraindications. Lack of knowledge about possible prior medical investigations.

Appendix 28: Raw data for the following question: How do you personally think can keep/refer decision making abilities be improved?

Relevant categories that emerged out of the data:

Yellow: More general information red flags.

Green: Specific lectures/presentations on red flags (clinical reasoning).

Blue: Case discussions.

Pink: Decision making algorithms/trees/tools.

Red: Experience.

Grey: *Not relevant for research question.*

Intervention group FH Vienna

1. More such presentations/lectures and cases during classes.
2. An independent lecture about red flags. A lot of cases but also theory.
3. Cases.
4. More clinical reasoning, more cases.
5. Exactly the same as it has been done here: theoretical background plus discussion of cases. But also let students make independent decisions based on cases. As part of the degree (e.g. clinical reasoning).
6. Courses, training, cases, supervision.
7. The class clinical reasoning should not be taught in English. More focus on red and yellow flags as part of individual classes.
8. More focus on red and yellow flags during physiotherapy classes (e.g. cases).
9. Guidelines or algorithms that aid with the decision making process (decision making algorithms which guide you to either start treatment or to referral).
10. More cases during classes. Maybe even independent lecture for this.
11. Education on red and yellow flags.
12. Through more experience, more such presentations/lectures/discussions as part of the undergraduate degree.
13. More interdisciplinary exchange with other professions. Further education/congresses about this aspect, more education during classes (but has been done).
14. More during the undergraduate degree. The cases which have been discussed were very good and should be part of the lecture "clinical reasoning".
15. More discussion based on cases; more complex thinking (reasoning).
16. An independent lecture during the undergraduate degree. "Clinical reasoning" was not enough for me. A lot of discussing such cases together.
17. Definite signs and symptoms, which require a referral and a check-up by a physician.
18. /
19. Sufficient available literature about red flags in general.
20. More knowledge about red flags; become more accurate with making such decisions.
21. Similar to this lecture-> discussion of clinical cases/vignettes. More attention during the clinical internship(s).

Control group FH Vienna

1. Maybe a decision making algorithm specific for individual pathologies.
2. Specific information when a medical referral/investigation is necessary.
3. Discussion of typical paper bases cases. More clinical reasoning during classes and not only in English.
4. Cases/vignettes, presentations, further postgraduate education, information material

5. This is already mentioned during classes. Yet, there is not independent lecture. Repetition or summary of red/yellow flags.
6. Specific guidelines that describe which signs/symptoms require a medical referral.
7. The lecture clinical reasoning should be taught in German. Even though it is important to speak English, this is such an important issue (being able to make accurate decisions) so that it should be taught in German (because of the matter of language clarification).
8. More diagnosis during the undergraduate degree + more theory and more in depth knowledge for e.g. oncology, orthopaedic-> avoidance of only obtaining superficial knowledge.
9. More about this during the undergraduate degree; yet a lot is also learned through experience.
10. Independent lecture, e.g. how to recognise a contraindication where there is also the focus on recognising relevant pathologies with their contraindications.
11. Better overview on red and yellow flags.
12. Independent lecture during undergraduate degree. Discussion of cases.
13. A list of red flags. I have heard of those but I cannot remember all of them
14. /
15. /
16. More cases during classes, more about red flags.
17. Discussion of similar cases during classes. A list of red flags + symptoms.
18. Presentations about red and yellow flags.
19. Classes on cases/vignettes and red/yellow flags.

Intervention group FH Kärnten

1. More practising with such cases-> very close to reality.
2. Through practising with cases. Experience (internship).
3. Tables and common connections. Talking to other physios.
4. /
5. /
6. Lectures that train us how to start thinking into that direction.
7. Through a precise questionnaire.

Control group Fh Kärnten

1. Working through cases during classes, to be better prepared when being in the clinic/private practice.
2. More info about red flags. Connections to certain pathological processes.
3. Specific guidelines when working in the clinic/private practice. "Mnemonics".
4. Independent lecture which aims at teaching us exactly how to do this. Courses outside the University.

5. More focus on red and yellow flags-> was discussed in only few classes. More focus in all lectures.
6. An independent lecture "red flags"; maybe together with other clinical tests. More discussion of cases/vignettes.
7. I do not think that there is a unique approach to this issue as every physiotherapist will have a different knowledge based on his course he/she attended – difficult.
8. /

Intervention group FH Sbg

1. Clear instructions, seminars, postgraduate education.
2. Through the discussion of cases (as in this lecture).
3. Cases seem to be a good method.
4. More information to the person/disease.

Control group FH Sbg

1. More specific information about red flags (cases, subject specific information). More information during internship if a patient could have been treated without an additional medical check-up or prior medical referral-> practical relevance during the undergraduate degree.
2. A lecture with similar/identical cases. Establishing influencing factors.
3. /
4. More education with a focus on internal problems/pathologies.

Intervention group FH Graz

1. Through specific teaching about red flags. How to integrate red flags into the clinical reasoning process. Cases!!
2. Discussion of cases (as done during the educational intervention). By doing so, you get a different perspective of the cases.
3. More discussion of similar cases in such a context. The undergraduate education is focused on a non-direct access system instead of a direct access context-> would be interesting.
4. Working with cases (plus discussion).
5. More problem based learning. Discussion of patients. More practically oriented lectures.
6. Discussion of cases within a group. Discussion of cases from clinical internship. Guidelines for red flags or maybe clues.
7. Benchmark of e.g. 2 contraindications requires a referral.

Control group FH Graz

1. More in depth education + interdisciplinary collaboration.

2. More practical experience.
3. More cases (similar to those 11) in the lectures. More specific guidelines when a referral is necessary.
4. Explanation of the medical perspective + background + possible consequences. In depth knowledge about medical connections. Especially for internal problems (-> signs of an inflammations etc).
5. More knowledge if a medical evaluation is really required + red flags and more evaluation; meaning generally more knowledge about red flags during the undergraduate degree.
6. Case discussion during a lecture-> easier to remember risk factors.
7. More information on alternative treatments and contraindications.
8. I personally think that exactly such cases would be optimal. In combination with a list of red flags + examination procedures which might be helpful for making a decision. Increased connection between pathology and physiotherapy; which can be done and when.

Interventiongroup FH Steyr

1. Combination of different specialised fields(subject areas) during classes plus case discussions with multi morbidity cases. Collaboration with MDs during case discussions-> practical lectures.
2. Special classes which deal with screening processes. More cases during classes.
3. More cases (discussion).
4. More cases discussion->complex cases. Similar to those in the lecture but more cases.
5. Meticulous anamnesis. Precise medical referral from MDs.

Controlgroup FH Steyr.

1. /
2. More concrete Screening methods; red flags.
3. More cases and clinical pattern during classes-> gives students more confidence.
4. More cases. Yellow flags-> how much yellow flags indicate contraindication for PT. Which combination of risk factors might be dangerous.

Interventiongroup FH Wels

1. Science based red flags.
2. More knowledge about red flags. Critical investigations. More knowledge about oncology/inflammatory processes.
3. /
4. Cases. Chat with MDs about their point of view on this topic. More in depth knowledge about oncology/internal medicine.
5. Case discussions with MDs and physios.

6. Lectures on this topic.

7. Common sense. Do's and Don't's. Red flags.

8. Similar lectures with many clinical cases to get a better feeling how to solve such cases. Group discussions.

9. Precise red flags- difficult.

10. More similar case discussions. Maybe also in classes with MDs to also see his/her opinion on indication for PT.

11. /

12. More background knowledge.

13. More experience – case discussion.

14. Workshops, case discussion.

Controlgroup FH Wels

1. More anamnesis concerning red flags. Distinction between red flags and indication for PT.

2. Through exactly such tests; more experience (practical or black/white).

3. More info on red flags.

4. More knowledge about pathology. Clear structure (procedure). Knowledge about guidelines. What is my level of responsibility, Highlight indication versus contraindication.

5. More cases during curriculum. Specific red and yellow flags.

6. When direct access is possible for PTs, when patient needs medical referral (more teaching about red and yellow flags).

7. More focus during undergraduate degree on how to recognize internal diseases and wound healing problems. Imaging procedures for PTs. How to read and interpret such imaging procedures.

8. /

9. When was his/her last visit to doctors office. Info about his own point of view.

10. Tools for making such decisions if patient needs medical referral. Currently decision based on red flags.

11. Discussion of red flags.

12. In depth knowledge on red flags. Risk factors and more knowledge about numerous pathologies (especially internal diseases).

13. /

14. /

15. NO clue.

Appendix 29: Raw data for the following question: Which part(s) of the additional lecture did you personally find most beneficial to help you to make an accurate keep/refer decision (based on the 11 vignettes)?

Please tell us why:

Relevant categories that emerged out of data:

Yellow: Cases practically related.

Green: Theory good for repetition.

Pink: Cases good for clinical reasoning and problem solving.

Grey: *Not relevant for research question.*

Intervention group FH Vienna

1. /
2. /
3. Attentive reading, clinical reasoning, better understanding of connections through theory and cases.
4. Repetition of theory and discussion of cases – important aspects were mentioned and repeated.
5. Theory helped as well – this was a good repetition of already learned things. Discussion of the cases was helpful as issues/approaches were questioned and substantiated.
6. “solution” were demonstrated, reflect together on the cases.
7. /
8. This was related to practice -> becoming more sensitive for the “small details” which need further questioning/examination.
9. /
10. Especially the cases promoted critical thinking ->creating new approaches.
11. /
12. Many different opinions. Recommendation of various solutions.
13. Theory was a good repetition. Cases were a good way of illustration.
14. Cases are more specific than theory-> discussion was very informative.
15. With this knowledge (theory) you learn to estimate the consequences and to assess if further medical attention is required.
16. Critical questioning and recognising when info is missing.
17. Theoretical background which symptoms might indicate an internal cause was helpful and what is rather typical for a mechanical problem. Cases were good for making the connection to a more practical context.
18. /

19. Practical relevance and the discussion within the whole group.
20. Group discussion was helpful. Different opinions which were either a confirmation or corrected me-> I could learn from that.
21. /

Intervention group FH Kärnten

1. Cases, as they were a good demonstration how to weigh the information, especially when there were different components. Theory can be included in everyday practice and helps to recognise warning signals.
2. Background knowledge was refreshed. It was however difficult as the (11) cases were shorter; yet, the learned way of thinking (during the case discussion) helped as well.
3. The thorough discussion of the cases provided clues and things that require attention.
4. That apparently simple symptoms might be a sign for something more. Relationship between e.g. lumbar spine and urogenital area.
5. /
6. Knowledge in combination with practice seems to be the best way.
7. Both parts included helpful aspects....[rest indecipherable]

Intervention group Fh Sbg

1. Cases were very practice related (which is good) – a lot to think about. Theory: for basis.
2. Theory for refreshing the red flags during patient interview and physical examination. Theoretical knowledge can be internalised during the cases.
3. Different mechanisms – non mechanical problem. Cases are a good way of practicing how to start thinking when a MD is necessary-> communication with MD.
4. The current cases (11) were different from those that were discussed during the lecture; hence these (11) were more difficult and there were other aspects why I made a particular decision.

Intervention group FH Graz

1. Structured repetition of red flags. Discussion of cases was a good preparation for practical use.
2. Theory was a good refresher of already obtained knowledge. Cases were good for transfer of knowledge for practical use. You were shown what to look for.
3. On the one hand, refresher of the theory, on the other hand practical use. Cases are very helpful as there is no such thing as black and white in physiotherapy practice. Room for discussion.
4. There was connection for the practical use (cases).

5. Theory was already known, but was a good refresher. Cases were interesting and made you start thinking.
6. Many theoretical points were already known. Cases demonstrated single case situations which animated you to start thinking.
7. Theory: Refresher of contraindications. Cases: Discussion of possible ways how to solve the problems.

Interventiongroup Fh Steyr

1. Good mixture of theory and practice-> Discussion. Concise conclusion of the main points. Resolution of cases.
2. Combination of theory and cases gives an idea how to handle such cases.
3. In some cases symptoms were similar and making a connection was possible. Content from lecture could be used too.
4. Connection of theory and practice was possible.
5. Theory is important for making complex clinical reasoning. Cases important for seeing the bigger picture.

Interventiongroup FH Wels

1. Unsure if lecture was beneficial as decisions had to be made very quickly (many decisions were probably based on "gut feeling").
2. Critical thinking and instructions on how to question red flags.
3. Cases were not always that clear. Theory as basis for clinical decisions important.
4. Not enough clinical cases. More specific cases.
5. Solution of cases gave opportunity to get more insight.
6. Learning on what to look for.
7. Common sense. Lecture. Degree.
8. Background knowledge but mainly cases – you get an idea on how to weight information.
9. In addition to theory you have a picture in your head.
10. Cases (remaining parts indecipherable).
11. /
12. Cases as implementation of theory into practice is made easier.
13. Cases: more experience and evaluation.
14. Combine knowledge.

Appendix 30: Raw data for the following question: Do you personally feel that the lecture was lacking something (which should be included in future lectures)?

Categories that emerged out of data:

Yellow: More Cases.

Blue: Non-spinal issues.

Green: Communication with other health professionals (MDs)

Grey: *Not relevant for research question.*

Intervention group FH Vienna

1. /
2. The lecture was very specific for spinal issues, maybe more examples from the rest of the body. Maybe cases which are really only PT OR only MD, if, of course, there would be more time.
3. No was really good.
4. No was very detailed.
5. /
6. /
7. Was very informative and the presentation was excellent. Thank you for the new information.
8. /
9. /
10. No
11. /
12. No
13. /
14. The lecture was very informative.
15. /
16. I would already love to have more information on this topic. Maybe a handout with all the references.
17. No
18. /
19. No everything was there.
20. A hand out.
21. /

Intervention group FH Kärnten

1. /

2. /

3. No there was a lot of helpful information.

4. In my opinion no. The lecture was very interesting.

5. /

6. /

7. /

Intervention group FH Sbg

1. Clear instructions on what to do. Recommendations. Graphical preparation.

2. /

3. Maybe include the topic communication with MDs into the presentation; it was mentioned during the discussion of the cases.

4. Not that I can think of something right now. Maybe more cases with independent diseases.

Intervention group FH Graz

1. I enjoyed the lecture. A summary on how to act after each case.

2. No

3. /

4. More cases.

5. It was really brought to the point. Maybe a guest-lecture one day!?

6. References and resources for clinical reasoning in connection with red flags.

7. /

Interventiongroup FH Steyr

1. Maybe pictures of cases.

2. No.

3. No.

4. Was really good. Maybe 1-2 more cases.

5. /.

Interventiongroup FH Wels

1. Was really good. Nothing was missing.

2. /

3. /

4. Nothing for solving cases. Maybe more cases to get a better understanding and for implementation in practice.

5. No

6. No was really good.

7. Cases were too long-> was difficult to remember details.

8. /

9. No

10. Excellent lecture. Interesting, should be incorporated into lectures.

11. /

12. No

13. /

14. /

Appendix 31: Abstract of published paper.



Physiotherapy 103 (2017) 352–360

Physiotherapy

Systematic review

Is keep/refer decision making an integral part of national guidelines for the physiotherapy profession within Europe? A review



Wolfgang Lackenbauer^{b,*}, Jessie Janssen^a, Hazel Roddam^a, James Selfe^b

^a University of Central Lancashire, UK

^b Manchester Metropolitan University, UK

Abstract

Background Keep/refer decision as the ability to independently determine whether a patient's condition is suitable for physiotherapy management (keep) or not (refer), is regarded as an core element in the World Confederation of Physical Therapists' (WCPT) Guideline for Standards of Physical Therapy Practice. However, it is currently unknown how individual European countries have implemented this in their national guidelines.

Objectives To determine if keep/refer decision making abilities are an integral part of national guidelines for the physiotherapy profession of member countries of the European Network of Physiotherapy in Higher Education (ENPHE).

Data sources A review was performed including medical databases, the grey literature and personal correspondence with professional ENPHE member associations. To gain the information of interest, all eligible documents were reviewed.

Results 11 national guidelines for the physiotherapy profession could be obtained. Two additional member associations use European guidelines as their national ones. Despite the fact that in the WCPT guidelines keep/refer decision making abilities are clearly described as a core element, there exists huge inconsistency as to how various European (with direct and non direct access systems) countries have included them in their national guidelines.

Conclusion Despite the fact that most ENPHE member countries deem a close collaboration between health care professionals important and that physiotherapists should know the limitation of their expertise, keep/refer decision making abilities as explicitly stated in the WCPT guidelines were not included in the majority of guidelines that were reviewed.

© 2017 Chartered Society of Physiotherapy. Published by Elsevier Ltd. All rights reserved.

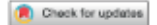
Keywords: Keep/refer decision making ability; Physiotherapy; National competency guidelines

Appendix 32: Abstract of published paper.

EUROPEAN JOURNAL OF PHYSIOTHERAPY, 2017
<https://doi.org/10.1080/21679169.2017.1408682>



ORIGINAL ARTICLE



Keep/refer decision making abilities of European final year undergraduate physiotherapy students: a cross-sectional survey using clinical vignettes

Wolfgang Lackenbauer^{a,b}, Jessie Janssen^c, Hazel Roddam^c and James Selfe^a

^aDepartment of Health Professions, Manchester Metropolitan University, Manchester, UK; ^bDepartment of Health Sciences, University of Applied Sciences Krems, Krems, Austria; ^cSchool of Health Sciences, University of central Lancashire, Lancashire, UK

ABSTRACT

Purpose: The recognition of pathological processes, which are not appropriate for physiotherapy, is a crucial part of the clinical reasoning process. Over recent years, there have been several research efforts investigating qualified physiotherapists and doctoral students' capability in making precise clinical decisions on whether a patient's condition is suitable for physiotherapy intervention (keep), or rather requires medical check-up (refer). No study so far has examined the keep/refer decision making abilities of final year undergraduate physiotherapy students within Europe.

Materials and methods: A survey containing 12 validated vignettes was distributed among 2238 final year undergraduate physiotherapy students from 15 different member countries of the European Network of Physiotherapy in Higher Education (ENPHE).

Results: Seventy-three respondents were included in the final analysis. Only slightly more than half (mean: 53%; median: 67%) of the medical critical vignettes were answered correctly. Just eight respondents (11%) correctly identified all three medical critical vignettes.

Conclusion: European final year undergraduate physiotherapy students are not sufficiently equipped with enough knowledge and skills to make very precise keep/refer decisions (based on clinical vignettes) and, most importantly, seem insufficiently trained to accurately identify more critical medical conditions which need a timely referral to another health care professional.

ARTICLE HISTORY

Received 14 July 2017
Revised 18 October 2017
Accepted 18 November 2017
Published online 28 November 2017

KEYWORDS

Keep/refer decision;
differential diagnosis; red
flags; physiotherapy;
medical referral

Keep/Refer-Decision-Making Abilities and Screening for Serious Pathologies as Integral Components of Physiotherapy Education and Profession

The Perspective of Austrian Physicians

Entscheidungsfähigkeit von Physiotherapeuten betreffend physiotherapeutische Indikation und Screening auf schwerwiegende Pathologien als integrale Bestandteile der Physiotherapie-Ausbildung und des Berufszweigs

Die Ansicht österreichischer Ärzte

Authors

Wolfgang Lackenbauer^{1,2}, Jessie Jansen³, Hazel Roddam³, James Selfe¹

Affiliations

- 1 Manchester Metropolitan University, Dept. of Health Professions, GB-Manchester
- 2 University of Applied Sciences Krems, Dept. of Health Sciences, A-Krems
- 3 University of Central Lancashire, School of Health Sciences, GB-Preston

Key words

clinical decisions, survey, physiotherapy, physicians

Schlüsselwörter

klinische Entscheidungen, Umfrage, Physiotherapie, Ärzte

received 26.02.2017

accepted 20.04.2018

Bibliography

DOI <https://doi.org/10.1055/a-0833-1759>

Published online: February 4, 2019

physioscience 2019; 15: 28–36

© Georg Thieme Verlag KG, Stuttgart · New York

ISSN 1860-3092

Correspondence

Wolfgang Lackenbauer, PT, MManipTh (Curtin), PhD Candidate Manchester Metropolitan University, Externer Dozent IMC FH Krems
Physio Point Bergheim, Dorfstr. 67, 5101 Bergheim, Österreich
wolfgang.lackenbauer@gmx.at

ZUSAMMENFASSUNG

Hintergrund In den letzten Jahren wurden mehrere Umfragen unter Physiotherapeuten zum Thema Direktzugang, erhöhter beruflicher Autonomie und Notwendigkeit des Erkennens schwerwiegender Pathologien durchgeführt.

Ziel Ziel des Fragebogens war es herauszufinden, wie Mediziner in Österreich dazu stehen, dass Physiotherapeuten mehr Eigenständigkeit bei klinischen Entscheidungen übernehmen.

Methode Im Herbst 2017 wurde eine Online-Umfrage per E-Mail an 1000 Hausärzte und 395 Orthopäden mit Privatordination in Österreich verschickt.

Ergebnisse An der Studie nahmen 76 Hausärzte (7,6 %) und 40 Orthopäden (10 %). Davon waren 90 % der Hausärzte und 68 % der Orthopäden der Meinung, Physiotherapeuten sollten eigenständig in der Lage sein zu beurteilen, ob Physiotherapie indiziert ist oder nicht.

Schlussfolgerung Die Studienteilnehmer sahen es mehrheitlich positiv, dass Physiotherapeuten in Österreich mehr Verantwortung übernehmen und eigenständig beurteilen, ob eine Indikation zur Physiotherapie besteht.

ABSTRACT

Background Several surveys over the last few years examined physiotherapists' attitude towards direct access, increased practice autonomy and the necessity to detect the presence of serious pathologies.

Objective The aim of the questionnaire was identify the attitude of Austrian physicians towards physiotherapists' taking more responsibility in the case of clinical decisions.

Method An online survey was distributed by e-mail among 1000 general practitioners and 395 orthopaedic surgeons working in private practice in Austria during autumn 2017.

Results The study included 76 general practitioners (7.6 %) and 40 orthopaedic surgeons (10 %). 90 % of the responding general practitioners and 68 % of the orthopaedic surgeons believed that Austrian physiotherapists should be able to decide whether physiotherapy is indicated or not.

Conclusion The majority of the study participants were in favour of Austrian physiotherapists taking more responsibility and that they independently decide about physiotherapeutic indication.

Appendix 34: Journal editor's letter of acceptance for publication

View Letter

Date: 19 Jul 2019
To: "Wolfgang Lackenbauer" wolfgang.lackenbauer@stu.mmu.ac.uk
From: "IJTR Editorial Office" ijtr@markallengroup.com
Subject: Your Submission - ijtr.2019.0001R2

Ref.: Ms. No. ijtr.2019.0001R2

Evaluation of the feasibility, acceptability and potential effectiveness of an educational intervention which aims to improve the keep/refer decisions making abilities of Austrian undergraduate physiotherapy students: A randomised pilot study
International Journal of Therapy and Rehabilitation

Dear Mr Wolfgang Lackenbauer,

I am pleased to tell you that your work has now been accepted for publication in International Journal of Therapy and Rehabilitation.

It was accepted on 19 Jul 2019

The next step is for the article to be copy-edited and formatted into the journal's house-style. In due course, you will receive another email from us asking you to check a proof copy of the edited article.

Thank you for submitting your work to this journal.

With kind regards

Vicki Williams
Editor
International Journal of Therapy and Rehabilitation

In compliance with data protection regulations, you may request that we remove your personal registration details at any time. (Use the following URL: <https://www.editorialmanager.com/ijtr/login.asp?a=r>). Please contact the publication office if you have any questions.

